NATIONAL MUSEUM OF VICTORIA

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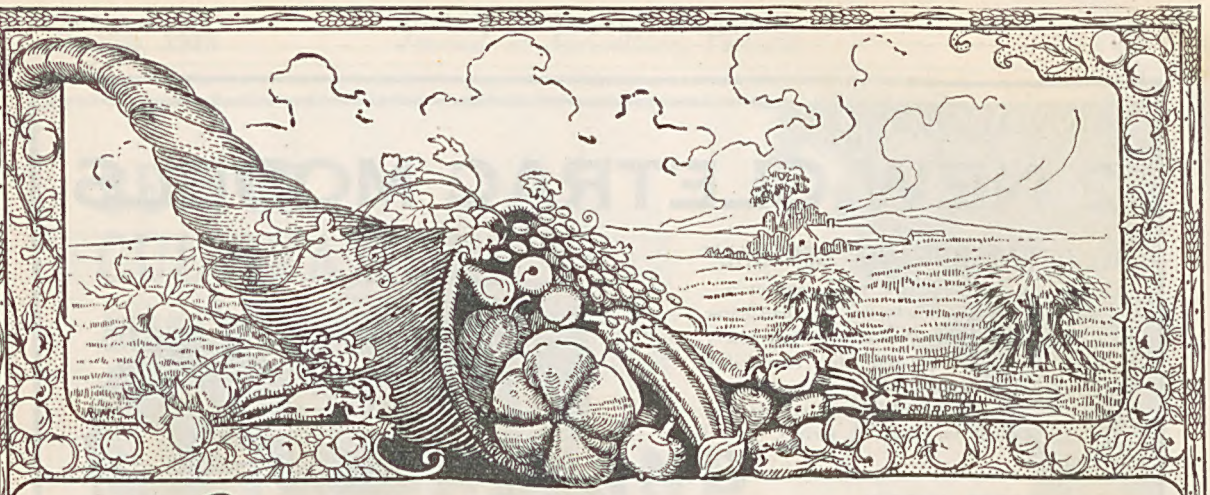

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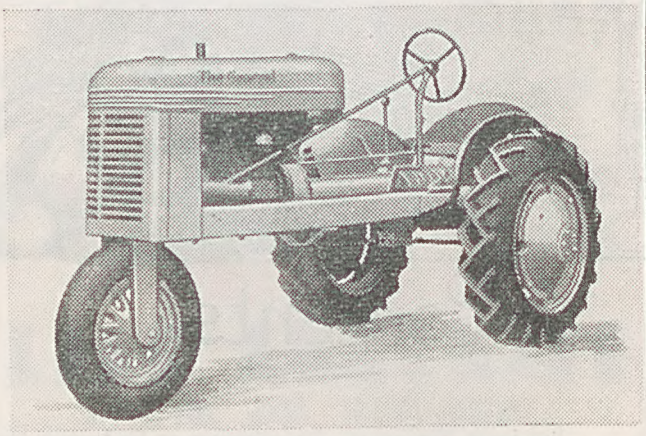

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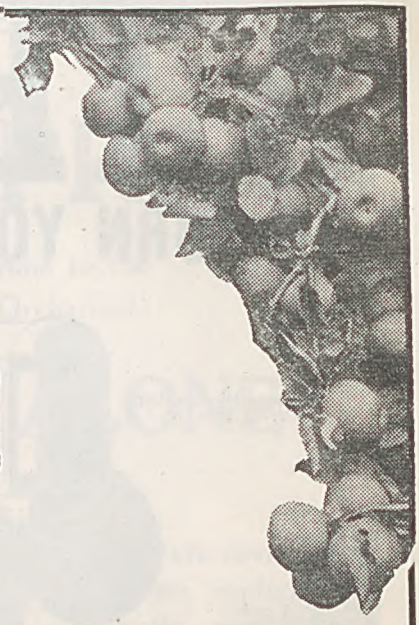

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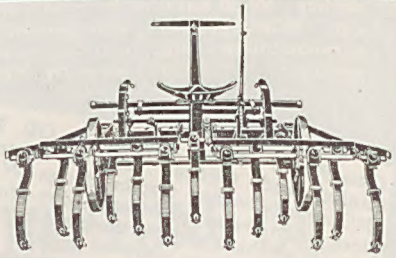

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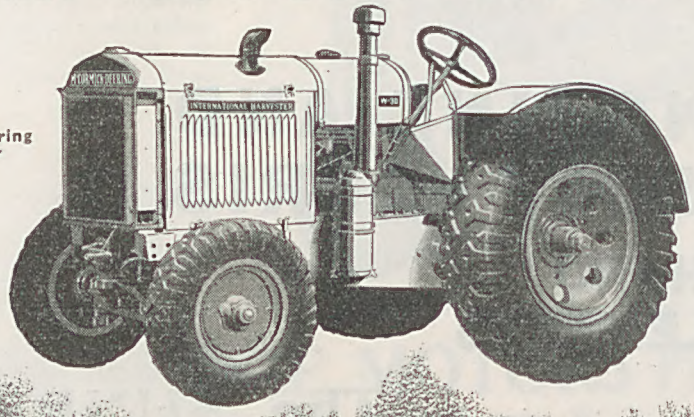

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Border Leicester and Southdown rams at Rutherglen.

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Fat Lamb Production

Investigations at Rutherglen Experiment Farm

By W. B. Miller, M.Agr.Sc., Senior Inspector of Agriculture

ONE of the outstanding advances made in Victorian agriculture during the past twenty years has been the increased production of fat lambs, resulting in, and facilitated by, the greatly increased export of frozen carcasses, mainly to Great Britain. This increase in the export trade is shown statistically in the following table:—

Years (Ended June).	Lambs exported from Victorian Ports (approx.).
	Carcasses.
Average 5 years—	
1919–20 – 1923–24	1,033,000
1924–25 – 1928–29	1,080,000
1929–30 – 1933–34	1,868,000
1934–35 – 1938–39	2,939,000

NOTE.—The above exports include a large but indefinite number of lambs from New South Wales which were slaughtered in Victoria, and also lesser numbers from South Australia and Tasmania. Approximately 1,500,000 lambs are used annually for local consumption in Victoria.

Many factors contributed to the rapid increase in lamb production in Victoria and adjacent areas of New South Wales and South Australia, the principal ones being a satisfactory and more profitable price for lamb than for wool and mutton, a great improvement in the pasturage available in many districts as a result of top dressing with superphosphate, and a rapid expansion in the area of subterranean clover. The low prices obtained for wheat during the years 1930 to 1935 also encouraged greater production of lamb in the wheat-growing districts.

The increased production has been so great that concern is now felt as to whether the available markets can absorb the present and potential supply, and the existence of quotas* imposed by the British Government on the total imports of Australian lamb and mutton into Great Britain emphasizes the fact that markets are not unrestricted. It is most important, therefore, that attention should be

* This article was prepared prior to the outbreak of war.

paid to improving the quality of our lamb exports in order that they may return the highest possible price and compete successfully on the British market with lambs from New Zealand, Argentine and other smaller exporters. That such improvement can be made is generally recognized, although much detailed investigational work is required to achieve the desired result in an economical manner.

It is not proposed to survey in this article the many factors affecting lamb quality, but merely to state that during the past three years the number of second and third quality lambs exported from Victoria has exceeded that of first quality, and that the ideal to aim at is an export lamb of first quality weighing less than 36 lb. frozen carcass weight. It is not expected that this ideal will be completely achieved for a great many years to come, as seasonal and district conditions play such a large part in production. The market requirements also change from year to year, but it is evident that the increasing demand for light weight quality lambs in Great Britain, and to a lesser extent in Australia, will be expressed in a price differentiation between such lambs and those of heavier weight and/or lower quality. The following table, supplied by the Australian Meat Board, summarizes the exports for the past three years:—

LAMB CARCASSES EXPORTED FROM VICTORIA TO THE UNITED KINGDOM.

	1936–37.		1937–38.		1938–39.	
	Number.	Average weight.	Number.	Average weight.	Number.	Average weight.
		lb.		lb.		lb.
1st quality	1,209,000	36	1,163,000	35	1,158,000	34
2nd quality	1,567,000	32	1,497,000	30	1,166,000	29
3rd quality	416,000	28	497,000	26	424,000	25
Total ..	3,192,000	33	3,157,000	31	2,748,000	30

From the viewpoint of the individual farmer or grazier the utilization of pasture to best advantage is essential and requires attention and investigation to the same extent as pasture improvement itself, the object being to obtain the maximum net return per acre over a number of years consistent with the maintenance of the numbers and health of the stock. The farmer realizes the importance of quality of meat in both the export and local markets, but naturally considers the problem of improved quality in relation to the quantity produced and the prices obtained for various qualities.

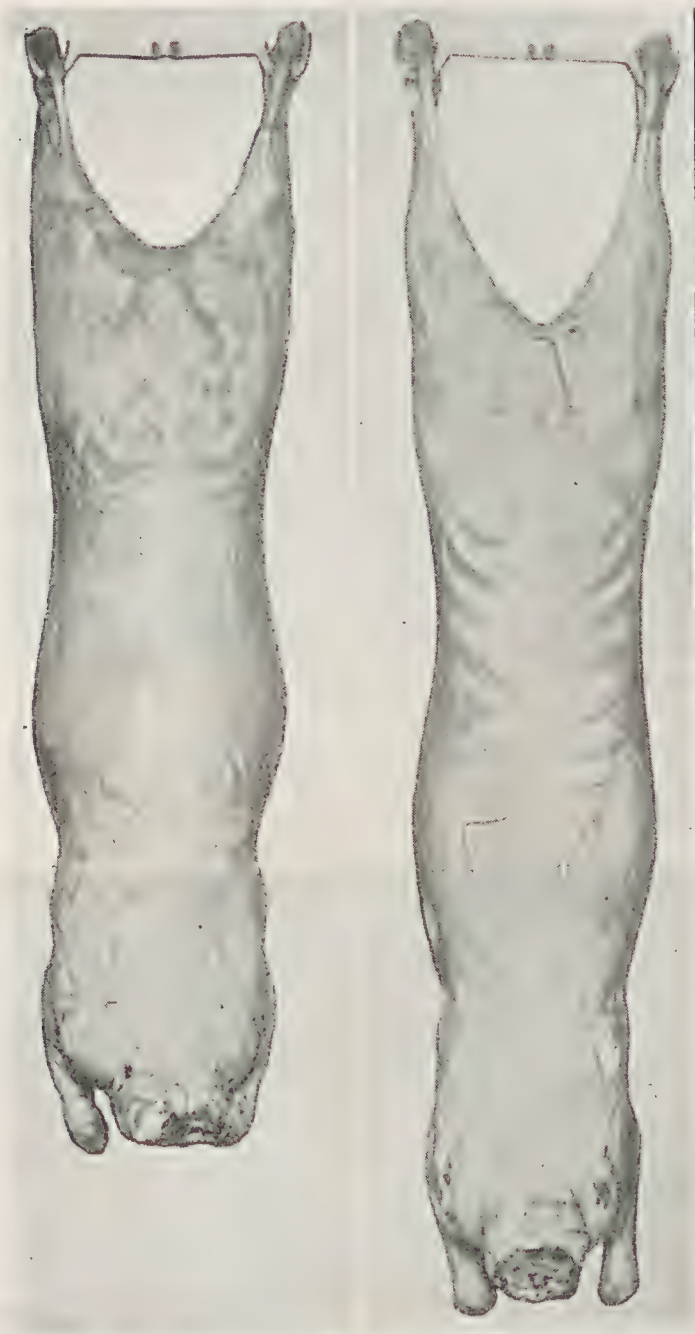
Influence of Breed.

The influence of breed and types of both ewes and rams is recognized as an important factor in lamb raising, and many breeds contribute to the sheep population of the lamb-raising areas.

Although the sheep of Australia are predominantly Merino it is recognized that the English breeds must be used to a considerable extent in the economic production of export lamb, even though the wool of the ewe mother and the lamb skin cannot be forgotten as a by-product of the lamb industry. We find therefore that Comeback, half-bred and cross-bred ewes are utilized as mothers of fat lambs and that nine breeds of English rams are used as sires while the Corriedale and Polwarth breeds also play a part. The particular crosses most suitable for various conditions require much investigation, although in broad outline those most adaptable to specific environments are known to some extent.

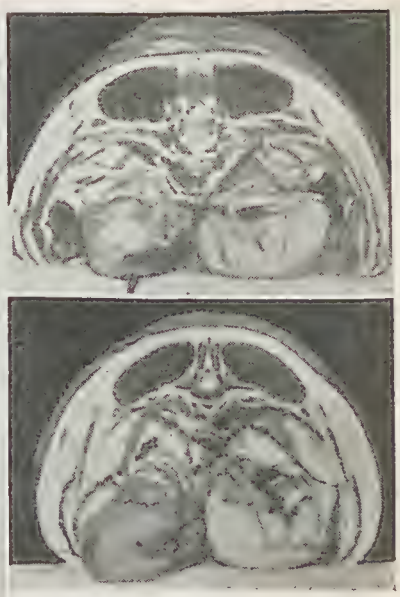
For example, in the drier or marginal areas where fat lambs cannot be consistently produced (New South Wales supplies most of our ewe requirements), Merino blood is used to a greater extent than in those wetter districts typified by a longer and more reliable growing period of improved pasture. In the former areas, Merino or Comeback ewes are commonly mated with Border Leicester, Dorset Horn, or Romney Marsh, and less commonly with English Leicester and Lincoln rams. The wether portion of the progeny finds its way into either the lamb or mutton markets, while the ewe portion may be sold as lamb for slaughter or later for breeding purposes in the more reliable fat-lamb producing areas. The marginal districts are climatically well suited for the economic production of half-bred or Comeback ewes to be utilized as mothers of fat lambs, but further investigation as to the particular cross which will prove most satisfactory for the various districts is required.

In the more reliable fat-lamb producing areas in which the greater portion of Victoria may be included, many breeds of rams may be and are used with the many types of ewes available. Under very favorable conditions there is little doubt that the type of sire exemplified



The Down and Merino types of carcass. Two first quality Australian lambs of the same weight (33 lb.) with a difference in carcass value of 2/9. Note the full, level loin, good "eye" of meat, good short legs and full wide shoulders of the Down type carcass on the left compared with the Merino type carcass on the right.

[Aust. Meat Board.



Transverse cut across hind portions of loins of Down type carcass (above) and Merino type (below).

by the best strain of the Southdown breed mated with a half-bred or stronger ewe will produce with great degree of certainty the ideal export lamb type.

In areas not quite so reliable but which cannot be regarded as marginal there is much doubt as to which breeds should be used, taking all factors into consideration. Ewes commonly available are the Merino, Comeback, Corriedale cross, and half-breds of various crosses, while the most popular breeds of ram are the Border Leicester, Southdown, Dorset Horn, Ryland, and English Leicester. Suffolk, Shropshire and Corriedale rams are also useful for specific conditions.

With the object of studying the problem of the relative value of various crosses for fat-lamb production, investigations were commenced at the Rutherglen Experiment Farm in 1932.

A Dorset Horn ram.

Climate and Pasture at Rutherglen.

The average total annual rainfall at the Rutherglen Experiment Farm is 23.1 inches, the monthly averages being approximately January (1.4 inches), February (1.5 inches), March (1.7 inches), April (1.5 inches), May (2.0 inches), June (2.7 inches), July (2.2 inches), August (2.3 inches), September (2.3 inches), October (2.2 inches), November (1.6 inches), and December (1.7 inches).

As in most Victorian districts with a similar rainfall (20 to 25 inches per annum), that is, in the belt of country stretching some 350 miles from Rutherglen in the North-east to Edenhope in the Western District, and including such towns as Wangaratta, Nagambie, Heathcote, Maryborough, Stawell and Balmoral, the rains in the first three, and last two, months of the year are very unreliable, but it is seldom that sufficient rain is not received in the remaining seven months to provide green pasture. The amount of feed, however, varies considerably from year to year, and it is in the winter period that feed shortages are usually most critical.

The soils at Rutherglen are of three main types—(*a*) friable red clay loams, usually well drained and undulating, (*b*) grey cementy loams, containing buckshot, on the flatter and lower-lying areas, and (*c*) gravelly hill soils. In this district pasture top-dressing and the introduction of subterranean clover have been responsible for the transformation of the grass areas from wool growing to fat lambs as their main production. This change has taken place coincident with a large increase in carrying capacity, e.g., in the Rutherglen shire, nearly 100,000 acres of a total area of 135,000 acres, are devoted to grazing of sheep and cattle. The number of grown sheep at 1st March has increased from approximately 35,000 in the years 1920 to 1925 to 70,000 in the past few years, and the annual production of spring lambs has risen from a few thousand to about

A Ryeland ram.

Southdown cross lambs at the freezing works.

40,000 per annum. These numbers by no means represent the potential or full carrying capacity of the district as the largest area top-dressed in a single year to date is 38,000 acres.

The pastures of the district are typically native grasses of the wallaby, spear and summer growing species such as couch grass, to which have been added, as the result of encouragement by top-dressing and cultivation, such annuals as silver grass, brome grasses, barley grass and annual clovers and medicks. Subterranean clover, the principal one grown, has obtained a firm hold on both previously cultivated fields reverted to pasture and areas which have never been ploughed, and this aggressive species has increased both carrying capacity and soil fertility to a marked degree. Considerable areas of lucerne are also prominent, and introduced perennial grasses such as perennial rye grass and *Phalaris tuberosa* are established on smaller areas.

The carrying capacity of virgin unimproved country in the district is approximately one breeding ewe to 1¼ acres, but up to 2½ ewes per acre are maintained and their lambs fattened on the most improved pasture lands. Apart from foot-rot in wet winters, little trouble is experienced from sheep diseases, although pulpy kidney (*entero-toxaemia*) is causing some concern.

The intensity of stocking varies considerably also with the management policy adopted, and must always remain a question of judgment. Too heavy stocking results in inferior lambs, less wool cut per ewe, and the necessity for hand feeding in some seasons. Light stocking is conducive to high quality, heavier lambs when desired, greater fleece weights, a minimum of reject or "carry-over" lambs, less anxiety in poor seasons, but a smaller possible output and net return in a good season.

In the breeding experiments reviewed in this article, the sheep and lambs were grazed principally on top-dressed pasture, including a large but variable percentage of subterranean and other clovers, the remainder of the feed mainly being annual grasses. In the months of December to March the ewes had access to stubble following cereal crops. These top-dressed and improved pastures were stocked at what was considered to be an economic rate, approximately two ewes with their lambs per acre, and the lambs obtained were quite typical

of the production of the improved areas in the district. No hand or supplementary feeding was given and "show" lambs produced under special conditions were not sought.

Results of Trials.

To compare the relative value of a limited number of crosses used in fat-lamb production under heavy stocking conditions, straight lines of both half-bred (Romney Marsh x Merino) and large-framed Comeback ewes were mated with typical rams of the Border Leicester, Southdown, Dorset Horn and Ryeland breeds, at least three rams of each breed being obtained from leading stud flocks. In 1932 only Border Leicester and Southdown rams were included.

The variability in type amongst half-bred and Comeback ewes as described above is recognized, but the two types which were used satisfactorily served the object of the investigation. The Comeback ewes were ordinary trade sheep possessing a frame larger than the ordinary Merino, a plain body and a fleece the count of which was described as averaging 60-58's. The half-bred ewes were typical Romney Marsh-Merino cross of bigger and deeper frame than the Comebacks, and with a fleece of lighter but not much coarser character, the count of which was described as 56-58's. During the five years of the experiment the Comeback ewes shore an average of 1.1 lb. more wool than the half-breds.

The comparative wool value of the two types fluctuates, but in August, 1939, it was 10½d. and 10d. per lb. for the Comebacks and half-breds respectively. The total wool weights shorn vary considerably with the age of the ewes and the seasons, but over the full five years of the experiments and using the low current valuations the Comeback ewes produced wool valued now at 7s. per annum, against the half-breds' production of 6s. 1d. per annum.

In 1932, 250 half-bred and 100 come-back ewes, all seven years old, were utilized in the tests, and Border Leicester and Southdown rams were mated separately with equal numbers of each group. From 1933, Dorset Horn and Ryeland rams were added to the half-bred ewe matings, commencing with two-tooth ewes, there being at first 100 ewes in each of the four half-bred matings, and 50 in each of the two come-back ewe lots. These ewes were persisted with until 1937.

Half-bred ewes (Romney Marsh x Merino).

[Continued on page 475.

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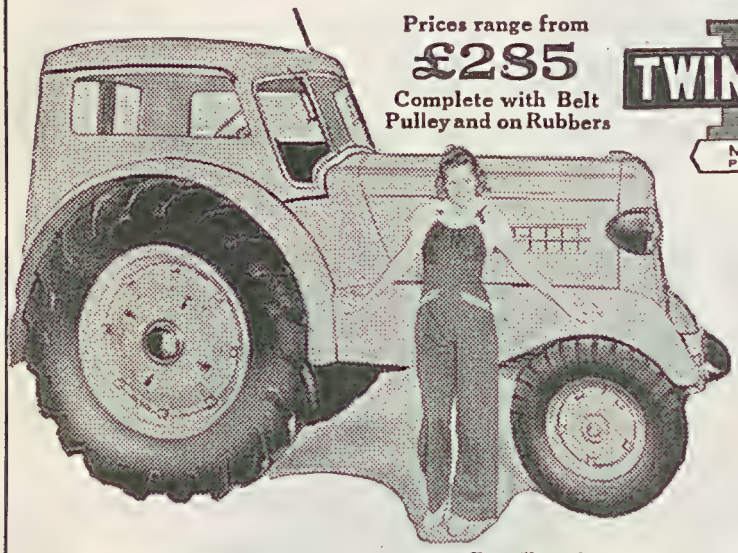

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State Research Farm

Annual Field Day

MORE than 500 farmers visited the State Research Farm, Werribee, on Friday, 29th September, on the occasion of the annual field day. The Governor (Sir Winston Dugan) attended, and took a keen interest in the proceedings.

In welcoming the visitors, the Minister of Agriculture (the Hon. E. J. Hogan) said that in recent years farmers had had a difficult time owing to low prices and the drought. The war had brought about an increased demand at higher prices, which, with the good season, should enable those on the land to recover their losses. Australians could assist Great Britain in the present crisis by increasing production as far as possible. Information as how best to do this was available to those present by studying the methods practised at the research farm.

The Director of Agriculture (Mr. H. A. Mullett) stressed the necessity for increased production as a war measure. So far, Britain had not signified in what direction its needs could best be supplied. It might be that more meat would be wanted, or Australian farmers might be asked to increase the area of crops not generally grown, such as flax. When the clarion call went out, the primary producers of Australia, who were better equipped than at any previous period, would answer it as never before.

The party was split up into groups, which inspected the various activities, including wheat breeding and general cereal culture, irrigation investigations, pasture management, and the breeding of Clydesdale horses, Friesian and Red Poll cattle, Suffolk and Ryeland sheep, and poultry.

The improvement of the yield of cereal crops is of material importance in this country, where the prosperity of the whole community depends to such a large extent on the primary industries. An increase in the yield of wheat of even half a bushel per acre, at present prices, represents a sum approximating £200,000 per annum. This amount constitutes a material addition to the spending power of the community. To the individual farmer an increase of half a bushel per acre may well decide whether he is to finish the year's operation with a surplus or a deficit.

The increase in production may be brought about in a number of different ways, such as the introduction of better varieties, by better manurial practices, by more effective disease control measures, and generally by the application of a wider knowledge of all the factors of plant growth.

The State Research Farm has been particularly successful in producing improved wheat varieties, which comprise 80 per cent. of the total area sown to wheat in Victoria, and 25 per cent. of that in South Australia. Oats and barley have also received attention commensurate with their importance to Victorian agriculture.

WHEAT EXPERIMENTS.

Wheat is by far the most important annual crop in Victoria, approximately 3,000,000 acres being sown each year. The chief activities of plant breeding and general crop improvement work of the farm are devoted to this cereal.

Considerable success has attended the efforts of the plant breeders in producing new wheats. The rapidity with which these wheats have displaced the older varieties is indicated by the accompanying table.

DISTRIBUTION OF WERRIBEE BRED WHEATS.

Year.	Acreage Sown in Victoria.	Percentage Total Area.
	acres.	%
1925	66,000	2
1926	195,000	6
1927	507,000	16
1928	1,000,000	25
1929	1,480,000	41
1930	2,680,393	56
1931	2,116,599	66
1933	2,628,945	82
1934	2,190,280	85
1935	2,117,118	88
1936	2,149,092	87
1937	2,255,933	81
1938	2,406,623	80

NOTE.—The statistics as to the varieties sown were not collected by the Government Statist in 1932.

The following are some of the more prominent wheat varieties which have been produced at Werribee:—

Ghurka is the most popular variety in Victoria, occuping 45 per cent. of the wheat area.

It has short straw, brown chaff, holds its grain well and yet strips readily, and is mid-season in time of maturity. One of its most valuable characteristics is that it is resistant to flag smut, and, in a lesser degree, to rust.

Ranee 4II is an early mid-season variety particularly suited to the drier areas of the wheat belt. It has brown, slightly tapering, tip-awned heads. It is the second most popular wheat in the State.

Regalia is a very early maturing variety, specially bred for Mallee conditions. It is expected to take the place of Rajah, holding its grain better, and being superior to it in yield and quality of grain.

Mogul has given particularly good results in the central and north-central districts, and over the past twelve years has out-yielded all others at Werribee.

Free Gallipoli served a very useful purpose for a number of years as a high-yielding variety adapted to a wide range of conditions. Owing solely to the fact that its flour is of low baking quality, it is no longer recommended for general use.

Sepoy is a late maturing variety which has yielded exceptionally well in the Mallee.

Variety Trials (Wheat).

All standard wheat varieties of importance in this State are grown in test plots at Werribee, and some of the results are given in Table I.

TABLE I.—YIELD OF WHEAT VARIETIES FOR VARIOUS PERIODS.

Variety.	Average 12 years.	Average 8 years.	Average 4 years.
	Bushels per acre	Bushels per acre	Bushels per acre
Midseason varieties—			
Mogul	24·8	24·6	22·4
Ghurka	22·9	24·5	22·6
Sepoy	22·6	23·4	21·2
Major	21·4	22·2	20·7
Free Gallipoli ..	21·2	20·3	20·8
Federation	18·2	20·6	21·0
Currawa	15·2	20·9	19·6
Early varieties—			
Ranee	23·6	23·6	22·4
Regalia	..	22·0	19·8
Dundee	..	..	19·5
Bencubbin	..	..	19·0
Ford	..	..	18·5
Nabawa	..	18·1	16·6
Baldmin	..	..	16·3

Many farmers are also interested in the progress of the new crossbred wheats, of which, as indicated in the section on cereal breeding, there are hundreds under test. The yields of a few of the best of these are given in Table II. None of these is available for distribution to growers until it has been tested for longer periods in other districts.

TABLE II.—YIELD OF NEW CROSSBRED WHEATS FOR VARIOUS PERIODS.

Variety.	Average 6 years.	Average 5 years.	Average 3 years.
	Bushels per acre	Bushels per acre	Bushels per acre
Ghurka x C.M.G. W5530 P2–2–2	..	..	24·8
Rajah x Gallipoli W6491 H2–4–3–4	25·2	24·9	24·4
Ghurka Seln. W595 O5 ..	..	..	23·9
Sepoy x Gallipoli W4081 L6–1	25·7	23·5	23·8
Free Gallipoli x Wannon W4073 L10–1 ..	..	24·9	23·4
Major x Ranee W6025 K1–1–1–2	25·9	23·8	22·6
Ghurka (check) ..	23·3	21·2	22·3
Ranee x Gallipoli W5899 J5–1–1	24·7	21·9	22·0
Major x Ranee W6021 K1–1–1–2	25·1	23·5	21·7

Quality Tests.—All new crossbred wheats are subjected to grain quality tests in the early stages of development, and those strains which prove unsatisfactory in this respect are discarded. In this way, it is possible to control the breeding work, so that the standard of grain quality of the new varieties will show a definite improvement on that of the older ones.

Fertilizer Trials (Wheat).

The practice of manuring has become almost standardized in this State. This process has been assisted by means of accurate experiments carried on here and elsewhere. The application of phosphates is a primary necessity owing to their deficiency in our soils. Evidence, however, is now accumulating that, under certain conditions, the addition of nitrogen is advantageous, while, in particular localities, remarkable results have followed the application of certain other elements which are used by the plant only in very minute quantity.

These questions are receiving continued attention on the farm, and the results obtained to date are given below.

Summary of Results.

At Werribee superphosphate is normally the only fertilizer required on a clean fallow.

The quantity of superphosphate giving the most profitable results is about 1½ cwt. per acre.

No profitable increase has been given either by potassic or nitrogenous manures or by lime.

Table III.—Effect of Fertilizers on the Yields of Wheat Grown on Fallow.

Average per acre for 22 years (immediate effect) and 4 years, 1925-26 and 1937-38 (residual effect).

Manurial Treatment.	Yield.	
	Immediate Effect Average 22 yrs.	Residual Effects Average 4 yrs.
	Bushels.	Bushels.
No manure	6·5	2·2
Super., ½ cwt.	14·3	3·6
Super., 1 cwt.	17·1	6·0
Super., 1½ cwt.	20·1	7·9
Super., 2 cwt.	20·6	9·6
Bone fertilizer, 1 cwt.	11·0	4·3
Thomas' phosphate, 1 cwt. ..	12·2	4·1
Super., ½ cwt.; Thomas' phosphate, ½ cwt.	15·3	4·0
Super., 1 cwt.; lime, 5 cwt. ..	17·9	4·7
Super., 1 cwt.; lime, 10 cwt. ..	18·8	6·4
Super., 1 cwt.; lime, 20 cwt. ..	18·5	6·9
Super., 1 cwt.; pot. sulph., ½ cwt.	18·1	5·0
Super., 1 cwt.; pot. sulph., ½ cwt.; soda nit., ½ cwt.	17·3	4·4
Super., 1 cwt.; soda nit., ½ cwt. ..	18·1	5·9
Super., 1 cwt.; soda nit., ½ cwt. (in spring)	18·4	6·7
Farmyard manure, 10 tons ..	15·2	7·8
Farmyard manure, 10 tons; lime, 10 cwt.	14·9	8·0
Super., 1 cwt. (continuously cropped)	9·4	
No manure (continuously cropped)	5·2	

On stubble crops best results are obtained by the use of approximately 1 cwt. of superphosphate plus 1 cwt. sulphate of ammonia.

Permanent Manurial Field.—These tests are of the single plot type, on fallow, and are in two alternate sections, one being in fallow, and the other in crop every year. The field was laid down in 1913, and each plot has received its appropriate application of fertilizer every alternate year since, with the exception of four seasons, two on each section, when an attempt was made to ascertain the residual effect of the treatments.

The lengthy period over which the tests have been continued, and the uniform nature of the treatment given, make them of exceptional value.

Residual Effect of Fertilizers.—In order to ascertain the residual effect of previous dressings, the usual applications of fertilizer were withheld in 1925, 1926, 1937, and 1938. Unfortunately, each of these seasons was characterized by very low rainfall and consequent low yields, and it is possible that, under conditions more approaching normal, the relative results may have been different.

Summary of Results.

The residual effects of some of the manures was extremely high.

The most marked effects were obtained from farmyard manure, and the heavier applications of superphosphate.

Insoluble phosphate, such as bone fertilizer and Thomas' phosphate, has shown, only in a minor degree, the long-distance effect with which it is often credited.

Potassic and nitrogenous fertilizers and lime give little sign of residual effect.

Portion of the Permanent Manurial Field.

TABLE IV.—COMPARISON OF RETURNS FROM VARIOUS DRESSINGS OF PHOSPHATIC FERTILIZERS ON WHEAT AFTER DEDUCTING COST OF MANURE.

Treatment.	Increase over "No Manure."	Net Extra Return per Acre over "No Manure."
	bus. p.a.	£ s. d.
Super., ½ cwt.	7·8	0 17 6
Super., 1 cwt.	10·6	1 2 6
Super., 1½ cwt.	13·6	1 8 0
Super., 2 cwt.	14·1	1 7 3
Bone fertilizer, 1 cwt.	4·5	0 2 9

The following values were used in compiling this table:—Wheat, 2s. 6d. per bushel; Super 4s. per. cwt.; Bone fertilizer, 8s. 6d. per. cwt.

Manurial Tests on Fallow.—These tests differ in several respects from those of the Permanent Manurial Field. They are situated on land which is of a volcanic clay character, and therefore typical of the bulk of the cereal-growing land in the district. They are of the replicated type, and, the site being changed each season, the results include not only the immediate effect of the manures applied in the tests, but also the residual effect of previous applications, comprising 1 cwt. of superphosphate in each two years out of every three. It is therefore emphasized that the following results may be expected only under those particular conditions.

TABLE V.—MANURIAL TESTS ON FALLOW.
Average Results: 3 years, 1934-36.

——	——	Increase over "No Manure."
	bus. p.a.	bus. p.a.
No manure	14·6	..
Super., ½ cwt.	20·8	6·2
Super., 1 cwt.	22·4	7·8
Super., 1½ cwt.	22·7	8·1

"Minor" Elements Manurial Trial.—Owing to the fact that the application of certain of the "minor" elements has been followed in the Wimmera and elsewhere in Australia by very beneficial effects, a test of this character was carried out at Werribee in 1938. The elements used, and the results obtained, are shown in the following table. It will be seen that, in this test, no beneficial effect followed their use.

TABLE VI.—"MINOR" ELEMENTS TRIAL, 1938.

Treatment. +Super., 1½ cwt.	Yield, Mean of Four Plots.
	bus. p.a.
Super. only	20·9
Zinc sulphate, 20 lb.	19·2
Magnesium sulphate, 30 lb.	19·2
Potassium sulphate, 1 cwt.	19·4
Manganese sulphate, 30 lb.	19·1
Copper sulphate, 15 lb.	11·8
Ferric sulphate, 56 lb.	15·3
Borax, 15 lb.	15·1
Significant difference required	2·0

The low yields obtained with some of these elements are due to different causes, including low percentage germination of the seed and an injurious chemical reaction with the soil, which indicates that their indiscriminate use is attended with some degree of danger.

Stacking shandy hay.

Manurial Tests on Stubble Land.—Trials were begun at Werribee in 1933 to study the manurial requirements of stubble land. It is known that one of the main benefits from fallowing comes from an increase in the supply of soil nitrate. It was therefore a reasonable assumption that an application of nitrogenous fertilizer would increase yields on stubble. **Using such a manure, in the form of sulphate of ammonia, in addition to superphosphate, the trials have resulted in marked responses being obtained from wheat, oats and barley.**

For purposes of comparison, the yields of oats and barley as well as wheat are given in Table VII.

The relative yields from the three cereals in this test indicate that wheat, as is well known, is not so productive as either oats or barley as a stubble crop and cannot be recommended for sowing under such conditions.

[*Continued on page* 484.

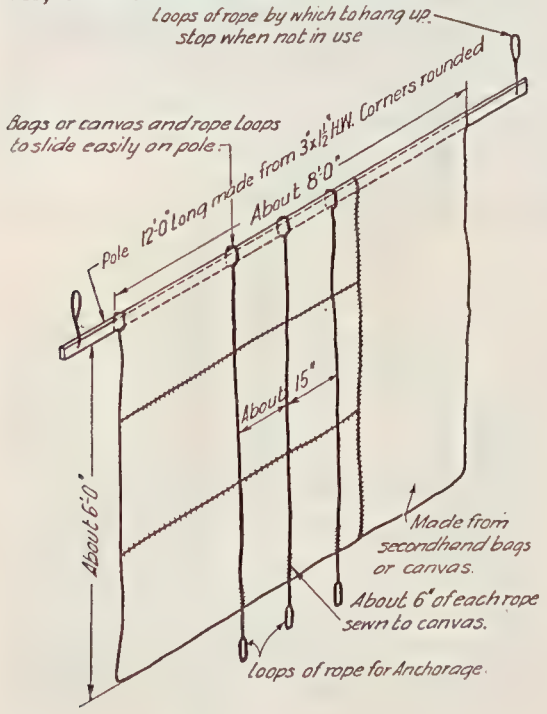
Irrigation Structures on the Farm

Contributed by the State Rivers and Water Supply Commission

A combination check drop and syphon with Dethridge meter.

THE efficient control of water on the farm is one of the essentials of a sound irrigation practice. Efficient control, however, cannot be obtained without the use of a certain number of structures—the constant use of earth stops not only increases the labour of irrigation but also destroys the land and wastes water.

Plans and specifications of a number of inexpensive appliances for use on the farm have therefore been prepared by the State Rivers and Water Supply Commission, and their adoption is recommended.


Loops of rope by which to hang up stop when not in use
Bags or canvas and rope loops to slide easily on pole
Pole 12'0" long made from 3"x½" HW. Corners rounded
About 8'0"
About 15"
About 6'0"
Made from secondhand bags or canvas.
About 6" of each rope sewn to canvas.
Loops of rope for Anchorage

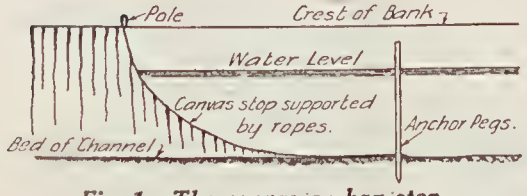


Fig. 1.—The canvas or bag stop.

The Canvas or Bag Stop.

Made from second-hand cornsacks or manure bags the canvas or bag stop is probably the cheapest structure on the farm. The commonest way of making it is by sewing together a number of opened bags and tacking them on to a piece of suitable timber. This is laid across the channel and the flap is then held in place by earth shovelled on to it.

The stop shown in Fig. 1, however, has the advantage that it does not need earth to hold it in place, and an opening to let portion of the water through can readily be made by slipping the canvas along the pole a short distance. In addition, the thrust of the water is taken by the ropes and the stop therefore lasts longer. Care should, however, be exercised to see that the stop is taken out after use and hung up to dry. If it is left on the channel bank the hessian soon rots and becomes useless. Stops of the same type may be made of canvas or other similar material, but this adds considerably to the expense.

The Wooden Stop.

Where channels join, and on flat sections of channel where a number of bays can be irrigated from the channel at the same level,

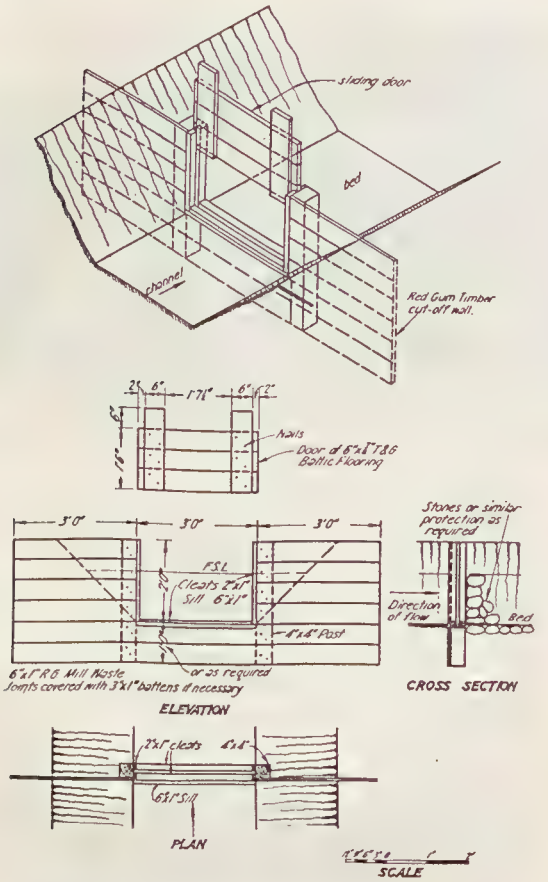


Fig. 2.—The wooden stop.

a permanent stop is preferable. This may be made either of timber or concrete. Where redgum, particularly waste, can be obtained direct from the mill, making from timber is the cheaper method. The diagram, Fig. 2, shows the size of stop for a channel 3 feet wide on the bottom and carrying 1 foot of water. There is a tendency in making such stops to economize on the door by making the gap too narrow—this causes a loss of head which may delay irrigation or even prevent a piece of higher land from being commanded. The opening must therefore have a waterway practically equal in area to that in the channel. The openings, however, should be made of uniform width so that doors may be interchanged and used where needed.

The Concrete Stop.

Used for the same purpose as the wooden stop, the concrete stop may be either precast or built in its permanent position. Precasting is preferable where a number has to be built; less material is required and time is saved. On the other hand, when built in position, less elaborate forms are required and reinforcing is not necessary.

Fig. 3 shows the design of a precast stop used in the Horsham district and known there as the "Godkin" stop. The material required for five of these stops is as follows:—

Cement, 2 jute bags.
Gravel, ½ cubic yard.
R.M. Steel, ⅜ in., 110 feet.
Netting, 85 square yards.
Bolts, 40.
Hardwood, 2 in. x 1 in.—39 feet.
1 in. x 1 in.—10 feet.

If the stop is to be cast in position, forms are needed only for the wing walls where they are above ground, and the timber for the door slots may form part of them.

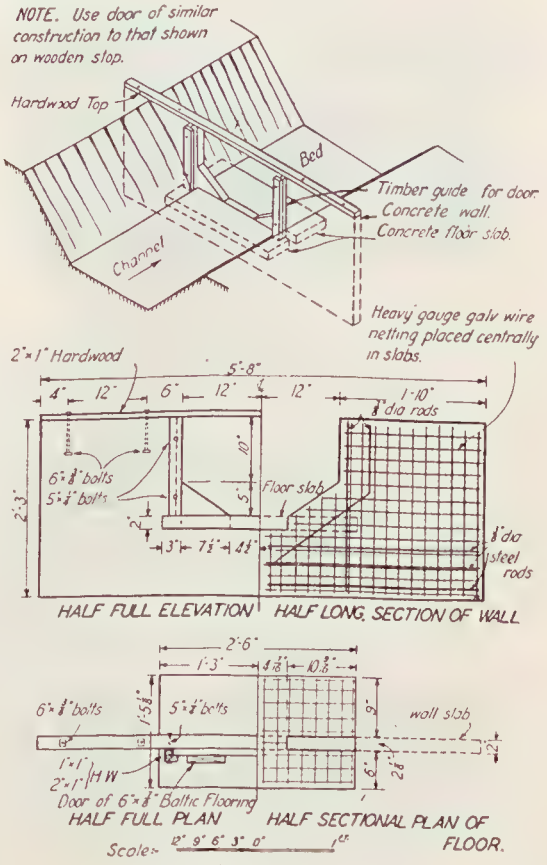


Fig. 3—The concrete stop.

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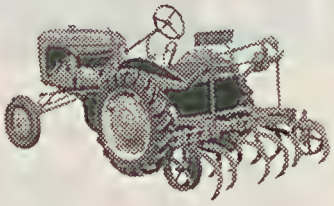

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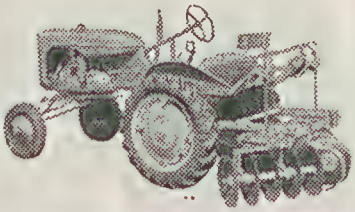

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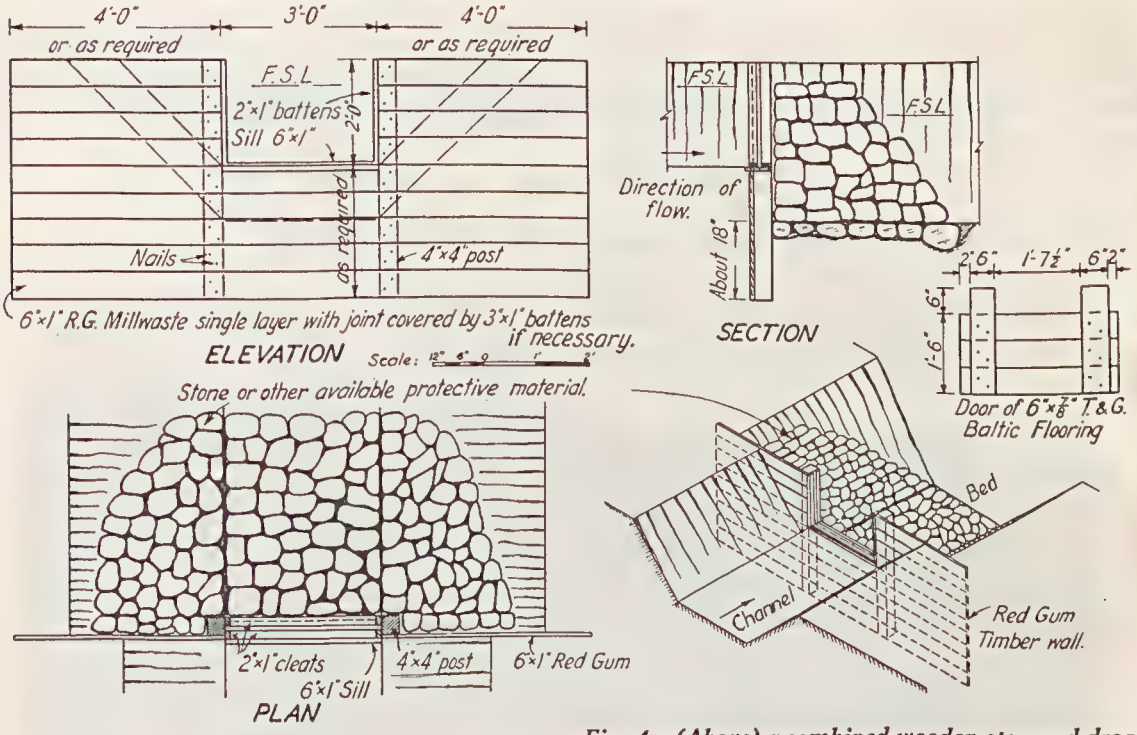

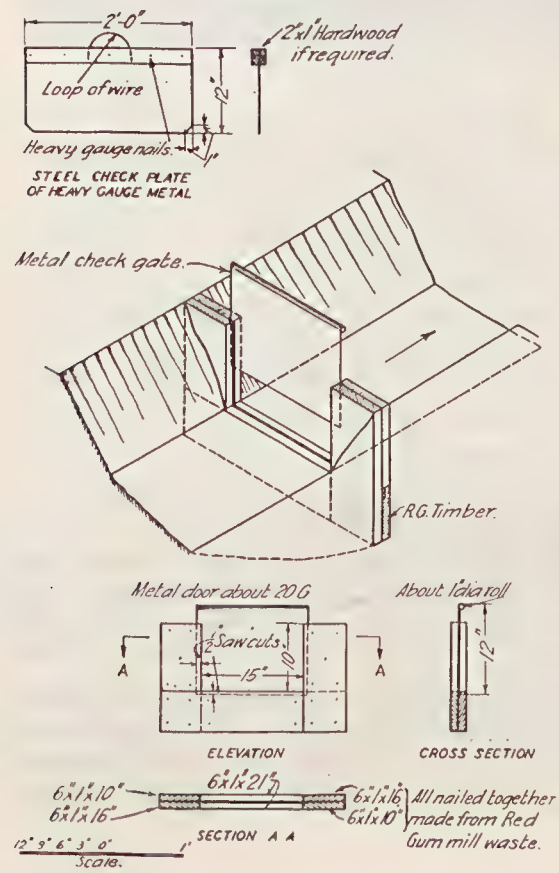

Fig. 4.—(Above) a combined wooden stop and drop.
Fig. 5.—(left) a wooden outlet.

Check and Drop.

Where the grade of the channel is such that scouring will take place if the channel is built to the grade of the soil, drops must be put in. The maximum grade at which scouring will not occur varies with the nature of the soil and the size of the channel, but for normal soil conditions and a channel with 2 ft. to 3 ft. bottom, carrying 1 foot of water, the maximum grade is in the vicinity of 3 inches per chain, and as a precaution drops should be provided where the grade is more than this amount. In making a check and drop the cut-off below the channel bottom must be made deeper, and the sill below the structure made larger and protected so as to take the wash of the water. This is shown in Fig. 4.

Outlets.

The usual method of releasing the water to the bays is through a cut in the bank. This has the following disadvantages:—

(*a*) Accurate control is difficult; it is a matter of using the shovel continually;
(*b*) Earth is lost at every irrigation; and
(*c*) Time is lost in making and filling the gaps.

Some form of outlet is therefore advisable, and an outlet to every bay should be the aim of every irrigator. This, however, takes time and money. While these are under construction a considerable saving of earth and time can be made by using a steel or iron plate, about 2 ft. x 1 ft., to hold back the water while the earth is being replaced in the gap. When this is done it can be removed and used elsewhere. Such a plate (Fig 5) can be cut from any heavy iron or steel sheet such as old iron tanks and petrol, oil, and bitumen drums. Stiffened with a piece of wood along the top, it may be pushed or driven into the soil.

Wooden Outlets.

Wooden outlets similar to, but on a smaller scale than the channel check shown above may be made. Fig. 5 is one of this type, which is effectual in loamy and clay loam soils. In sandy soils more cut off is necessary to prevent water soaking through and washing around the structure.

Concrete Outlets.

Concrete outlets may be made of a design similar to the concrete check, but of a considerably lighter construction. Such a one used in the Horsham District is shown in Fig. 6.

The material required for ten of these outlets is as follows:—

Cement, 2 jute bags.
Gravel, ½ cubic yard.
R.M. Steel ⅜ in., 96 feet.
Netting, 75 square feet.
Plain iron, 11 square feet.

In the construction of irrigation structures on the farm, considerable variation is possible, and by using local materials savings may be made. The Commission will at all times be glad to be advised of any inexpensive forms of farm structures, and its officers will advise irrigators in the construction of any of the structures outlined in this paper.

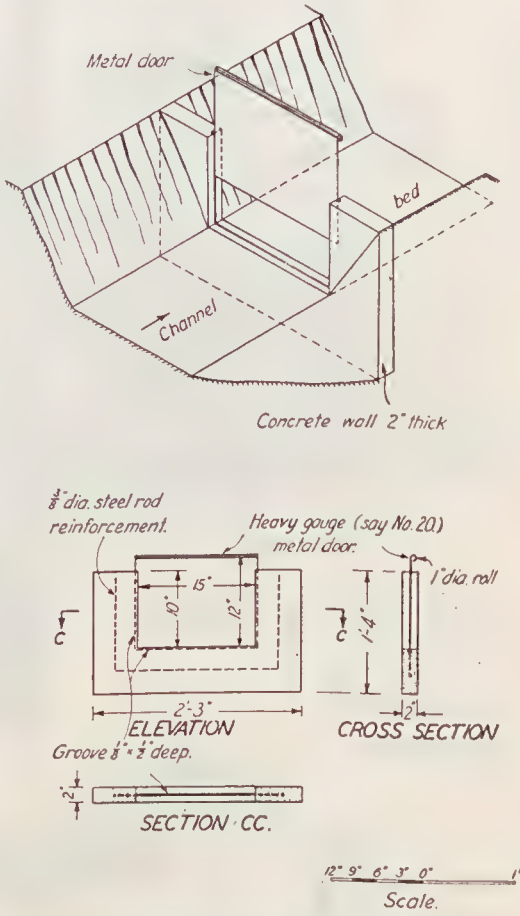

Fig. 6.—A concrete outlet.

Wireless Talks for Farmers

WITH the co-operation of the Australian Broadcasting Commission, the Victorian Department of Agriculture is conducting a series of wireless talks on subjects of particular interest to the man on the land. These talks are being broadcast from the regional stations, 2CO (Corowa), 3GI (Gippsland), and 3WV (Horsham) on Friday evenings, the 20-minute sessions commencing at 7.40 p.m.

The next talks will be on 13th and 27th October.

Listeners desiring any information connected with the management of their farm should send a letter to Mr. J. Keane, B.Agr.Sc., Department of Agriculture, Melbourne, and a reply will be given over the air. If you do not desire your name broadcast use initials or a nom-de-plume, but do not omit to mention your district.

Potato Manurial Trials

Results for 1938-39

By G. H. Mattingley, Potato Field Officer

A 13-ton crop of potatoes at Beech Forest.

THE plots comprising the late-sown section of the potato manurial trials conducted by the Department of Agriculture are situated in all the more important potato-growing areas of the State. These districts, in which the major portion of the acreage is planted during the period extending from the middle of October to the end of November, are favoured with a more reliable summer rainfall which is fairly well distributed throughout the growing period of the potato crop.

When these trials were first laid down a comprehensive range of manurial treatments was applied. After some years it became evident that the manurial application could be standardized, using, in the case of the volcanic soils, 3 cwt. super. per acre as a basis, and 6 cwt. super. per acre for all other soils. Sulphates of ammonia and of potash were incorporated with the basal super. dressing in varying quantities. Since that time the influence of artificial fertilizers on crop growth has been observed under a wide range of seasonal conditions at each centre where trials are conducted, and their performance has been such as to enable definite recommendations to be made regarding quantity and type of manure that can best be applied in any particular district. Following the publication of these results, the fertilizer companies have made available compound manures which conform to the recommendations made. The most important and widely known of these are super. and ammonia mixed in the proportion of 6:1 and 3:1.

The Season.

The area under potatoes in Victoria for the season just past was estimated by the Government Statist at 34,000 acres. This figure represents a decrease of approximately 7,000 acres on the acreage planted the previous year. Potato prospects at the beginning of the 1938-39 season were unfavourable. Existing conditions, owing to the continued drought, were said to be the worst that had ever been known. Cutworms caused extensive damage to crops as they appeared above ground, but in most cases the timely application of poison baits proved highly effective in controlling this pest. The grub of the potato moth also caused much harm to the earlier maturing varieties.

During the latter part of February the whole aspect was changed by heavy rains which fell over the central and eastern portions of the State, and in some cases record crops of Snowflakes were expected. The break in the weather came too late in the season for the Carman variety and while it increased the tonnage per acre, it spoilt the sample through excessive second growth. Unfortunately, however, the February rain was not followed up and conditions again became serious until the advent of good falls during April, which had, in some cases, a marked benefit on late-planted Snowflakes, but for the most part, produced a rough sample.

Yields in the central highlands, where most of the late crops are grown, were around the three-ton mark. In the Western District, which missed the rains, the late crops were a complete failure and in many cases growers were barely able to harvest sufficient for their own seed requirements. The Otway Forest and Neerim districts, where yields of from 5 to 7 tons per acre were common, were the only ones which could be considered as giving fair yields.

Harvesting became increasingly difficult as the season progressed owing to the rapid and dense growth of weeds which followed the heavy rains in April and May. In several instances the mower was used to cut the growth so that diggers could find the potato stalks and work in comparative comfort. A fair percentage of damage from glassy or wet end was reported in the earlier-sown Snowflake crops, even those in the late hill country being affected. This trouble became noticeably less as the late-sown crops were marketed. Several severe frosts in July caused many tons to be rejected at loading platforms. Very little pitting was carried out during the season for prices were at such a payable level that growers preferred to sell straight out of the paddock. Occasional pits are to be seen, but these are mostly composed of tubers dug in wet weather that were too muddy to be accepted by buyers, or a last truck retained as a speculation.

Beech Forest.

The Beech Forest district was an exception to the rest of the State this season, for as it possesses an average rainfall of 60 inches per annum, the drier, warmer conditions, coupled with an adequate rainfall proved ideal for the growth of potatoes. Throughout the Otway

A fine crop of Late Carman potatoes.

districts high yields of good quality potatoes of excellent shape were obtained, which commanded an appreciable premium on the market throughout the season whenever they appeared.

The plot was sown on the 6th December with Late Carman seed that had been sprayed with formalin at a strength of 1 lb. in 10 gallons of water as a precaution against seed-borne scab diseases. The land had previously been out to grass for a period of years and had been given only one ploughing and a harrowing before being sown with a mechanical planter. Consequently planting was rather rough as unbroken sods held together by grass roots prevented the formation of a good covering mulch and in addition made it difficult to cover the sets at an even depth. Growth during the season was good, the no-manure plot being noticeably more backward than the others, while those plots receiving ammonium sulphate were much denser and greener in the foliage.

Because of the regular incidence of the high annual rainfall at Beech Forest the maximum efficiency can be expected from the artificial manures applied to crops. The outstanding feature of these trials, which have been conducted on the farm of Mr. A. J. Towers for the past eight years, is the consistent performance of the super. and ammonia compounds as compared with super. alone.

In Table I., which shows the results harvested on 2nd June, 1939, it will be seen that the addition of sulphate of ammonia has increased very considerably the yield effected by super. alone. This is also apparent in Table II., in which the average results for the eight years' tests are given. It would seem that the dressing of super. 6 cwt. and ammonium sulphate 1 cwt. is the most profitable one to use at Beech Forest in an average season. The heavier dressings often produce higher yields, as in the case of super. 9 cwt. and ammonium sulphate 2 cwt., but it is very doubtful whether this dressing would prove profitable year in year out.

Another feature of note is the very definite lack of response by the crop to the application of potash. This may, in part, be accounted for by the fact that the potato land in this district is comparatively new, containing quantities of bracken roots and scrub ashes, each of which is a source of potash. For the time being, at least, it appears that sufficient potash for the needs of the crop can be provided from this source. In any event potash is a costly fertilizer, and response to it must be definite and consistent before its use can be advocated.

TABLE I.—POTATO MANURIAL TRIALS, BEECH FOREST, 1938-39.

Manure per Acre.	Weight Marketable Tubers.	Increase due to Manure.	Percentage Increase.
	T. C.	T. C.	%
Super., 6 cwt. ..	6 5	1 6	26
Super., 6 cwt. + amm. sulph., 1 cwt. ..	7 19	3 0	61
Super., 6 cwt. + amm. sulph. 2 cwt. ..	7 12	2 13	53
Super., 6 cwt. + amm. sulph., 1 cwt. + pot. sulph., 1 cwt. ..	7 14	2 15	55
No manure	4 19	..	..
Super., 9 cwt. ..	6 3	1 4	24
Super., 9 cwt. + amm. sulph., 1 cwt. ..	7 9	2 10	50
Super., 9 cwt. + amm. sulph., 2 cwt. ..	6 18	1 19	39

TABLE II.—AVERAGE RESULTS, BEECH FOREST, FOR EIGHT YEARS 1931-32 TO 1938-39.

Manure per Acre.	Average Yield.	Percentage Increase.
	T. C.	%
Super., 6 cwt.	5 5	54
Super., 6 cwt. + amm. sulph., 1 cwt.	7 5	113
Super., 6 cwt. + amm. sulph., 2 cwt.	7 12	123
Super., 6 cwt. + amm. sulph., 1 cwt. + pot. sulph., 1 cwt. ..	7 1	107
No manure	3 8	..
Super., 9 cwt.	5 14	67
Super., 9 cwt. + amm. sulph., 1 cwt.	7 11	122
Super., 9 cwt. + amm. sulph., 2 cwt.	8 6	144

Toombullup.

The Toombullup district is situated in the north east, about 40 miles in a southerly direction from Benalla. Comparatively unknown, this area for years has supplied the local demand for potatoes. It is particularly well suited to the production of potato crops, as it possesses a good friable red loam in a rainfall area of 40 inches.

Planting was carried out on 8th November. The soil was very dry and powdery, and had been cultivated and harrowed several times before sowing. Two crops of oats preceded the potatoes, which were Late Carmans that originally came from the Beech Forest district.

The plots were harvested on 14th June in the presence of local farmers, who have taken a keen interest in the trials since they were established in the district two years ago. Although two years' results are insufficient on which to base any definite recommendations, it would appear from the results available that the compound manure super. 6 cwt. and sulphate of ammonia 1 cwt. is likely to prove most profitable. The addition of ammonium sulphate to the superphosphate has in all cases resulted in a much greater increase in yield than that obtainable from the super. alone.

A field-day gathering on the experimental plots at Toombullup.

Here again, the application of potash to the potato crop seems to be of little value. In no instance has the addition of potash to the basal super. dressing resulted in even half the increase produced by the addition of ammonia, and in every case no significant variation in yield is obtained by adding potash to the super. and ammonia compound to form a complete manure.

TABLE III.—POTATO MANURIAL TRIALS, TOOMBULLUP, 1938-39.

Manure per Acre.	Weight Marketable Tubers.	Increase due to Manure.	Percentage Increase.
	T. C.	T. C.	%
Super., 3 cwt. ..	3 16	0 9	13
Super., 3 cwt. + pot. sulph., 1 cwt. ..	4 3	0 16	25
Super., 3 cwt. + amm. sulph., 1 cwt. ..	5 18	2 11	76
Super., 3 cwt. + amm. sulph., 1 cwt. + pot. sulph., 1 cwt. ..	5 12	2 5	67
No manure	3 7	..	..
Super., 6 cwt. ..	4 16	1 9	43
Super., 6 cwt. + pot. sulph., 1 cwt. ..	5 7	2 0	70
Super., 6 cwt. + amm. sulph., 1 cwt. ..	6 12	3 5	97
Super., 6 cwt. + amm. sulph., 1 cwt. + pot. sulph., 1 cwt. ..	6 10	3 3	94

The yields obtained last season are shown in Table III., while in Table IV. the average results for the two years' duration of the tests are set out.

TABLE IV.—AVERAGE RESULTS, TOOMBULLUP, FOR TWO YEARS 1937-38 TO 1938-39.

Manure per Acre.	Average Yield.	Percentage Increase.
	T. C.	%
Super., 3 cwt.	4 4	35
Super., 3 cwt. + pot. sulph., 1 cwt.	3 17	24
Super., 3 cwt. + amm. sulph., 1 cwt.	5 5	69
Super., 3 cwt. + amm. sulph., 1 cwt. + pot. sulph., 1 cwt. ..	5 5	69
No manure	3 2	..
Super., 6 cwt.	4 8	42
Super., 6 cwt. + pot. sulph., 1 cwt.	4 14	52
Super., 6 cwt. + amm. sulph., 1 cwt.	5 18	90
Super., 6 cwt. + amm. sulph., 1 cwt. + pot. sulph., 1 cwt. ..	5 18	90

Neerim.

Weather conditions were dry on 11th November when the Neerim plots were sown, and remained so until the break in February, which enhanced prospects of a satisfactory crop. Since then the season proved exceptionally favourable for potato crops and good tonnages were harvested, although in some cases rough second growths spoilt the sample.

Owing to the dry weather the strike was very much below normal, and in order to get a true indicaton of the performance of the various manures, 50 plants were harvested out of each plot instead of taking the usual chain strip. It has been estimated that there are 12,000 potato plants to the acre in the average crop; therefore, the actual number of plants harvested represents 1-240th acre.

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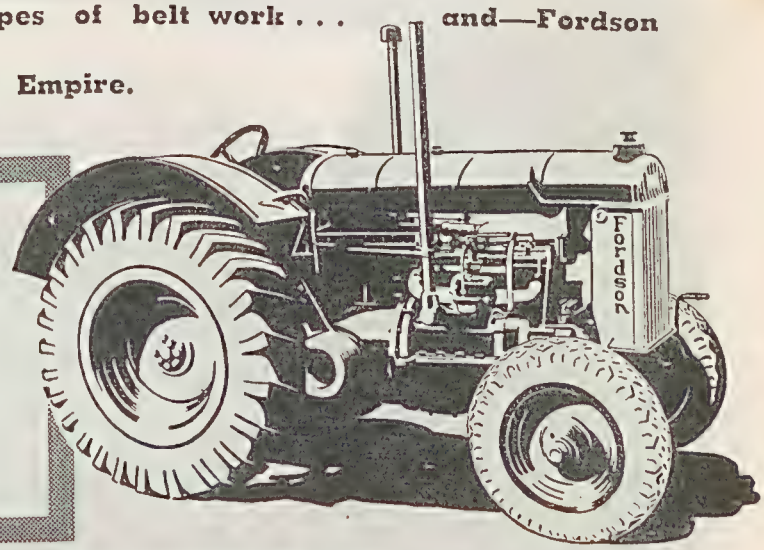

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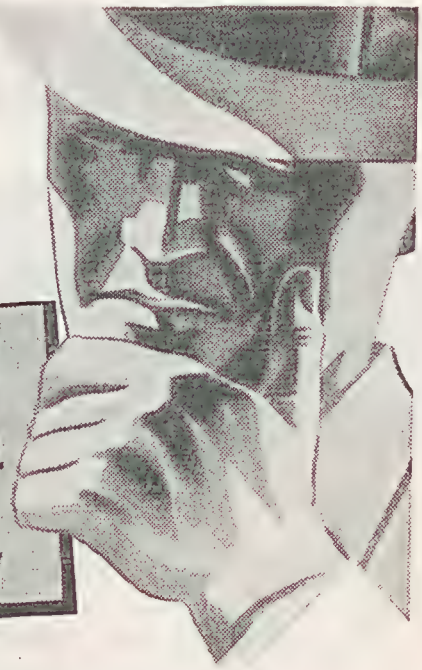

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THROUGHOUT THE BRITISH EMPIRE MOST PEOPLE RIDE ON DUNLOP TYRES

This plot continues to show a marked improvement due to the application of artificial manures. Potash appears to have a definite beneficial effect on the yield of potatoes in this district, while sulphate of ammonia seems to be of little or no value, thus rendering it, together with Warragul, unique among the potato lands of Victoria in this respect. But there are two years' results only to hand so far, as the plot was first established in November, 1937, and no definite conclusions can be drawn from such insufficient data.

In Table V. the results for last season are given, while the average results obtained for the two years are set out in Table VI.

TABLE V.—POTATO MANURIAL TRIALS, NEERIM, 1938-39.

Manure per Acre.	Weight Marketable Tubers.	Increase due to Manure.	Percentage Increase.
	T. C.	T. C.	%
Super., 4½ cwt. ..	5 7	1 5	30
Super., 6 cwt. ..	6 2	2 0	49
Super., 6 cwt. + pot. sulph., 1 cwt. ..	7 10	3 8	83
No manure	4 2	..	..
Super., 6 cwt. + amm. sulph., 1 cwt. ..	5 1	0 19	23
Super., 6 cwt. + amm. sulph., 2 cwt. ..	6 0	1 18	46
Super., 6 cwt. + amm. sulph., 1 cwt. + pot. sulph., 1 cwt. ..	6 2	2 0	49

TABLE VI.—AVERAGE RESULTS, NEERIM, FOR TWO YEARS 1937-38 TO 1938-39.

Manure per Acre.	Average Yield.	Percentage Increase.
	T. C.	%
Super., 4½ cwt.	7 8	47
Super., 6 cwt.	8 11	69
Super., 6 cwt. + pot. sulph., 1 cwt.	9 7	85
No manure	5 1	..
Super., 6 cwt. + amm. sulph., 1 cwt.	7 1	40
Super., 6 cwt. + amm. sulph., 2 cwt.	8 8	66
Super., 6 cwt. + amm. sulph., 1 cwt. + pot. sulph., 1 cwt. ..	9 1	79

A high-yielding crop of Late Carmans in the Neerim district.

Garden Notes

By A. W. Jessep, M.Agr.Sc., B.Sc., Dip. Ed.,
Principal, School of Horticulture, Burnley.

WITH a plentiful supply of soil moisture and the days gradually becoming warmer, seeds of any of the following autumn annuals may now be sown:—Antirrhinum, Aster, Carnation, Celosia, Cosmos, Gaillardia, Geum, Marigold, Nasturtium, Phlox, Petunia, Salvia, Sunflower and Zinnia. They should be transplanted as soon as they are large enough.

Perennials, such as Gladiolus, Chrysanthemums, Perennial Asters, Agapanthus, Nerines, Tuberous Begonias and some early Dahlias may be planted this month.

Plant out such climbers as Tecomas, Convolvulus, Dolichos, Mandevillea, Mina lobata, Solanum, Thumbergia, and Passion Fruit.

Chrysanthemums.

During the past few years, a distinct improvement has been made in the decorative or garden types. Some of these bloom well into the winter and give flowers in a time of scarcity. Chrysanthemums are easily propagated from cuttings, or root division; the Cascade types grow well from seed. It is better to grow the Exhibition types from cuttings; they will then have a better root system and produce fewer suckers than will plants from root division.

The cuttings should be taken just after the plant has finished flowering. Select fairly mature wood, nip out the top and make the cuttings 4 inches to 5 inches long. Plant them in rows 6 inches apart with 3 inches between the cuttings in the rows. Any good garden soil is suitable. Have about one-third of the cutting above ground. The cuttings root along the stem and quickly establish themselves. In about six or eight weeks from planting they should be ready for transplanting into their permanent position.

There are two main types of Chrysanthemums, the Exhibition, and the Decorative. The Exhibition type may be grown in the garden, but if very choice blooms are required, they must be specially treated in a manner somewhat as follows: Make up some soil consisting of four parts good loam to one part well rotted cow or stable manure. To this add about 2 or 3 lb. superphosphate and about the same amount of lime.

Select an open position sheltered from strong winds where the drainage is good, and make the bed running east and west. A convenient width is 3 feet, and raise it by using 9-in x 1-in. boards on edge along the sides. Consolidate the bottom of the bed and give it a coating of lime. Add the prepared soil and firm it so that it will be about 2 inches below the top of the boards. In this, plant two rows in October, placing the plants 9 inches from the boards with 18 inches between the plants. When the plants have commenced to grow, nip out the tips to make them branch uniformly. Do not allow more than three stems per plant and stake and tie up each stem separately. As the number of breaks and buds produced will depend on the variety, it is necessary to know the habits of the particular varieties one is growing and treat them accordingly.

A framework covered with calico blinds is necessary to protect the blooms on wet or very sunny days, and from heavy dews during the nights. An alternative method is to grow the plants outside in receptacles and when they commence to flower, remove them under cover to allow the blooms to develop. This involves a good deal of trouble, but it is essential if those beautiful blooms seen at the Show displays are to be obtained.

The Decorative types do not require much attention. They should be planted about September, and nipped back in November and December to prevent them from flowering too soon, as Chrysanthemums are usually required for late autumn and early winter blooms. They should not be watered too much as hard wood gives the best results. Most of the plants will be bushy and carry a mass of flowers, and should be disbudded if extra choice blooms are desired.

Varieties:—Some of the best varieties to grow for Exhibition purposes are—

1. Japanese Incurved: William Turner White; this is very popular. Lady Huntingfield; plum-crimson, with silvery reverse. Sir Frank Clarke; chestnut crimson, with rich gold reverse. Pink Turner; pink. Edith Cavell; orange bronze.

2. Japanese Reflexed: Autumn Tints; salmon buff. Golden Champion; golden yellow. Coronation Pink. Miss E. Alston; yellow.

Decorative types include: Pockett's Late Bronze; bronze, for winter flowers. Source d'or; bright orange bronze, midseason. Healesville Sunset; reddish apricot, late flowers. Lilian B. Bird; quilled pink flowers, late. Chieftain; pink. Pockett's Late Crimson; crimson, late.

Red Rover which is chestnut red, and Georgeous, a bright crimson, are two good single varieties.

The Vegetable Garden.

Now that the weather conditions have improved, the sowing of vegetable seeds and transplanting of plants should take place as soon as circumstances permit.

Asparagus stalks should be kept well cut for the next two months. If they are slow in developing, give the bed a light dressing of sulphate of ammonia at the rate of 1 oz. per square yard. Sow the main crop of Culinary Peas, using the popular midseason variety Greenfeast. Yorkshire Hero has lost its popularity and of late years, Greenfeast has been much more satisfactory.

Make a small sowing of French beans; Brown Beauty is an early-maturing and high-yielding variety with very good pods. Startler is the variety of Butter Beans which does well in Victoria; it is a high yielder of tender pods which should be picked when they turn a golden colour.

Frost-tender plants, such as Pumpkins, Squashes, Melons, Cucumbers, Egg plants and Sweet Corn may be planted this month. Tomato plants should be transplanted in October. Care must be taken to select varieties suitable to particular districts.

Make sowings in their permanent positions of seeds of the following:—Red Beet: Crimson Globe and Rapid Red. Carrots: St. Valeny and Early Shorthorn. Parsnip: Improved Hollow Crown. Swede Turnip: Champion Purple Top and Earliest of All. Onions: Brown Spanish, or Imperial.

Sow seeds of the following in a seed-bed and transplant as required:—Cabbages: Drumhead or Improved Succession. Celery: Improved White Plume and Golden Phenomenal. Lettuce: New York or Iceberg.

As the ground is still cold, keep the beds that have been planted well hoed, to enable the warmer air to enter and prevent the soil from setting.

Orchard Notes

By J. L. Provan, B.Agr.Sc., Senior Horticultural Instructor.

DURING the early part of October, Packham's Triumph, Winter Nelis, Josephine and William's pears will be completing their blossoming periods and all these varieties will require the calyx spray of arsenate of lead at the "petal fall" stage. Josephine, Winter Nelis and Packham's Triumph provide a valuable trio for cross-pollinating in the orchard; William's and Beurre Bosc also are good inter-pollinators. The William's sets fruit very satisfactorily without cross-pollination, but growers who have provided cross-pollination for this variety will notice that less misshapen pears are obtained and losses from windfalls are reduced.

The main blossoming period of apples occurs during October, and Jonathan, Granny Smith, Dunn's, Stewarts, Yates and Delicious will be in full bloom during the second or third week. These will be followed by Rome Beauty and London Pippin. Apple trees should be sprayed with the pre-blossom and post-blossom applications for the control of Black Spot and, towards the end of the month, lead arsenate calyx sprays will be required for the control of Codling Moth. Full details of the control measures for Black Spot and Codling Moth of both apples and pears are contained in the Instructional Circulars issued by this Department and an illustrated leaflet is attached to these circulars showing the stages at which the spray should be applied. Copies may be obtained free on application to the Director, Department of Agriculture, Melbourne, C.2.

Early this month the late flowering varieties of cherries, Bigarreau Napoleon, Florence and St. Margaret, complete their blooming period. The first-named frequently sets good crops without cross-pollination, but, generally, the provision of pollen of other varieties which bloom at the same time increases the setting

of cherries. For the popular late variety—St. Margaret—Reine Hortense, Florence and Bigarreau Napoleon will be found useful pollinators.

A strict watch should be kept for the development of Cherry Aphis and, if it appears, a nicotine sulphate spray, 1 pint in 80 gallons, plus 2 lb. of soft soap, should be applied before the insects become too numerous. If the Pear and Cherry Slug is noticed, arsenate of lead, 2 lb. (paste) in 80, plus 1 lb. of calcium caseinate spreader, should be added to the nicotine sulphate spray and the soft soap omitted.

The catkins, or pollen-bearing blossom, of the walnut trees commence to elongate about the end of September and, by the second week of October, they are fully developed and in bloom. At the same time the terminal growth has made six or seven leaves and the female blossoms have opened. Some varieties of walnuts mature the pollen-bearing catkins before the female blossoms open, and provision must be made for the planting of varieties close by, to provide pollen for pollination purposes. The walnut blossoms are wind pollinated. If space does not permit the planting of trees for pollination purposes, grafts of suitable varieties can be placed on the trees which require pollination.

The first spray of dry-mix lime sulphur should be applied to peaches for the control of Brown Rot and Rust when the "stockings" fall from the developing peaches. This spray is used at the rate of 25 lb. in 100 gallons. If aphis has appeared on the peach trees, nicotine sulphate can be combined with the dry-mix lime sulphur. A strict watch should be kept for the presence of Green Peach Aphis and the spray should be applied as soon as any are noticed, because their numbers increase rapidly if weather conditions are favourable.

Apricot trees, after the fruit has set, will not tolerate strong copper-containing sprays, but if Freckle has been troublesome in past seasons, growers can apply a 1¼:1¼:40 Bordeaux mixture spray during the first week of October, just as the "caps" fall from the fruit. Growers are warned, however, that this spray may cause a pink blush on the fruit which, later, may interfere with its disposal to the cannery.

Fertilizers Act

Result of Appeals

THE appeals against the convictions in the Court of Petty Sessions at Sunshine on 9th June, 1939, which were reported in the July issue of this *Journal* came on for hearing in the Court of General Sessions before His Honour Judge Richardson on 25th and 28th August, 1939. Mr. Sproule, K.C., appeared for the Department of Agriculture, and Mr. N. Mitchell, with Mr. Dunn, for the appellant, "G. W. Pennell."

His Honour allowed the appeals and quashed the convictions in the lower Court. He refused to allow costs against the prosecution.

The matter which determined the quashing of the convictions related to the taking of the sample of ANA Surprise Animal Fertilizer. The evidence of two Departmental chemists stated that the sample was withdrawn from three bags in a row of 30 bags which were selected for sampling, and which stood in a passage in front of a large stack of bags, the 30 bags being branded and labelled ANA Surprise Animal Fertilizer.

Mr. A. G. Pennell and two of his employees gave evidence that the sample was withdrawn from one bag in the front row of 30 bags and from two bags in the front tier of the stack at the back. Further, it was stated that the 30 bags consisted of ANA Surprise Animal Fertilizer which was being prepared for the Western Australian trade.

In giving judgment His Honour said:—First, as to the prosecution under section 16. This is a prosecution for an offence, and therefore of a quasi criminal nature, and I have to be satisfied to a very strong degree that the case is proved. I was prepared to give judgment this morning had the evidence been only that for the prosecution, holding that the case was made out; but having heard this evidence which had been given by Mr. Pennell and his employees, I cannot feel satisfied as I should be that the sample which was analysed by Mr. Robertson, and which forms the subject matter of this prosecution, was taken from what has been called Local ANA Fertilizer stacked in a row of some 30 odd bags on the floor of that shed. That row was the bulk of fertilizer as to which evidence was given showing that three samples were taken, and purporting to show that the various requirements of section 17 of the Act have been complied with. I am not satisfied that the ANA Animal Fertilizer analysed by Mr. Robertson is the fertilizer which was taken from the front row of bags.

The evidence seems to point more or less strongly to the fertilizer which was taken from that front row being the K and a diamond, Western Australian, Fertilizer. That is sufficient, I think, to dispose of the case.

As to the other prosecution under section 44, on my finding on the first prosecution it is not established what was found in the particular fertilizer the subject of the charge; and that finding must dispose of the second prosecution also.

I was prepared to say it was not proved to my satisfaction that this hydrolized leather was not offal. If the Department passes a word such as "offal," it must be prepared to take the consequences. I think this stuff can fairly be called "offal." It may be wise for the Department to see in the future that raw materials are not too vaguely described.

Both appeals will be allowed.

Fat Lamb Production

(Continued from page 458)

In each year, the ewes were carefully drafted to ensure evenness in each lot as regards condition. The ewes and the lambs of each cross were grazed together except at mating time, when equivalent feed was provided by careful rotation of the flocks. Complete records were kept regarding—

1. *Lambs.*—Time of lambing; percentage dropped, marked and fattened; rate of maturity; live and dressed weights of lambs slaughtered; quality and grade of carcasses; skin weights and values, &c.
2. *"Carry-over" Lambs.*—Live and dressed weights at various stages until sold; lamb fleeces; hoggett fleeces; skin values, &c., particularly in 1933-34 when a special investigation of "carry-over" lambs took place.
3. *Ewes.*—Wool weights and values, and values as aged fat ewes when disposed of.

Half-bred ewes (Border Leicester x Merino) with Southdown cross lambs at foot.

The lambs slaughtered for export were treated by the Amalgamated Freezing Co. (Vic.) Pty. Ltd. in 1932, and in later years by Western and Murray Co-op. Co. Ltd. and Messrs. Borthwick and Sons, Melbourne. Skins were valued by Messrs. Wilcox, Mofflin Ltd., and other valuers, and wool by Goldsbrough Mort and Co. Ltd.

The experiments as described above provide a reasonably complete picture of the performance of each cross under Rutherglen conditions. To the recorded weights and grades of lamb produced can be applied any schedule of values desired, and it is possible therefore to compare the performances of each cross in terms of current or anticipated market conditions.

Despite the careful planning of the experiment and the considerable number of ewes mated and lambs produced, it was found that such a test is not sufficiently comprehensive to cover the question of prolificacy. The average drop of lambs for six years was 93 per cent., the percentage of lambs reared to ewes mated being 85 per cent. The average annual loss of ewes from all causes was 2 per cent. Over the whole period of the experiment at Rutherglen there has been no consistent or significant variation in prolificacy of the various crosses, although considerable variation has been experienced in single years, particularly in the incidence of twin lambs. The recognition of the possibility of error by such chance variations made it necessary to ear tag every lamb and ewe in the trials. The results given for individual years refer only to single lambs, twins being excluded because of their chance incidence. For the above reasons, the method of interpreting the results as "returns per ewe" was not adopted.

The lambing periods, although reasonably prompt, varied somewhat according to the cross, depending on the ram as well as the ewe. The rams were joined each year late in December, and the general experience has been that the lambs from both types of ewe and sired by the Southdown and Dorset Horn rams appeared in the paddock approximately ten days earlier than those by the Border Leicester and Ryeland sires while the Comeback ewes lambed a week or so earlier than the half-breds. As the results are based on carcass weights on the one day at the end of the season (that is, from one lift) the late-dropped lambs were at a slight disadvantage but investigation of the relative performances of the early and late lambs in each cross showed that this factor did not affect the conclusions reached. In the experiments of the two years described, the average dates of lambing were 1932 (10th June) and 1935 (16th June). The slaughtering dates were 1932 (4th November) and 1935 (28th November).

A difficulty in such experiments is the assessment of the value of those lambs which, for various reasons, are not really fit for export as spring lamb when the pasture commences to dry off, when either lifting or shearing is necessary. Unless such lambs are included, the results may be misleading, and therefore, to make the experiments complete, it was decided to slaughter all the comparable lambs in 1932 and 1935, even though a small percentage normally would have been retained and shorn. These lambs appear as third quality carcasses in the tabulated results.

The percentage of dressed frozen weight to live weight on leaving the paddock varies considerably with condition, size and type. These average percentages in the 1932 and 1935 experiments were approximately as follows:—

—	1932.	1935.
	%	%
Half-bred ewes x Border Leicester rams	46	45
Half-bred ewes x Southdown rams ..	48	47
Half-bred ewes x Dorset Horn rams ..	..	46
Half-bred ewes x Ryeland rams ..	..	46
Come-back ewes x Border Leicester rams	45	44
Come-back ewes x Southdown rams ..	47	46

The first quality lambs gave higher, and the third quality lower percentages than the averages shown above.

In 1933, a special investigation of the "carry-over" lamb question was conducted, and the results obtained are discussed later in this report under the heading "Carry-over" Lambs. In 1934 the incidence of foot-rot made the experimental results unreliable, and in 1936 it was found impracticable to continue the experiment to its conclusion. In these two years, however, the evidence obtained did not conflict with the more satisfactory experiments of the three years reported upon in detail. In the past two years investigations have been concerned with other phases of fat-lamb production, principally the economic aspects of supplementary feeding and pasture management.

*Results of 1932 and 1935 Trials.**

The results of the trials in 1932 and 1935 are shown in Tables I. and II. Two schedules of prices per lb. based on weight and quality have been applied. Schedule No. 1 is that believed likely to operate for a greater part of the 1939 export season (emergencies excepted), but it is, of course, difficult to forecast prices as there will be variations from time to time, and even amongst buyers. The second

TABLE I.—RUTHERGLEN EXPERIMENTAL FARM.—RESULTS OF FAT LAMB BREED TRIALS, 1932.

—	Border Leicester Ram x Half-bred Ewe.		Southdown Ram x Half-bred Ewe.		Border Leicester Ram x Come-back Ewe.		Southdown Ram x Come-back Ewe.	
Number of lambs slaughtered	99		115		38		37	
Average frozen weight	35·9 lb.		33·7 lb.		32·2 lb.		30·3 lb.	
	No.	Average weight.	No.	Average weight.	No.	Average weight.	No.	Average weight.
Quality and Weight — Down Heavy (8's)	..	..	21	(38·5)	..	..	2	(38·0)
„ Light (2's)	..	..	59	(33·7)	..	..	22	(32·3)
First Heavy (8's)	44	(38·8)	1	(37·1)	7	(38·4)	..	..
„ Light (2's)	26	(33·5)	9	(33·7)	11	(33·2)	4	(30·5)
Second Heavy (8's)	14	(38·1)	..	..	2	(39·8)	..	..
„ Light (2's)	13	(30·0)	23	(29·6)	13	(30·1)	3	(26·8)
Third Heavy	..	..	..	..	..	..	..	..
„ Light	2	(25·5)	2	(26·0)	5	(23·3)	6	(22·0)
Average value of carcass—Schedule 1.	14s. 5½d.		15s. 0½d.		13s. 4d.		13s. 10½d.	
Average value of carcass—Schedule 2. ..	17s. 3d.		16s. 11½d.		15s. 6d.		15s. 4½d.	
Average skin value (1939)	3s. 1d.		2s. 6d.		3s. 2d.		2s. 6d.	
Average fat value	½d.		½d.		½d.		½d.	
Total value of lamb—Schedule 1.	**17s. 7d.**		**17s. 7d.**		**16s. 6½d.**		**16s. 5d.**	
Total value of lamb—Schedule 2.	**20s. 4½d.**		**19s. 6d.**		**18s. 8½d.**		**17s. 11d.**	
Estimated results had the experiment been conducted in two "lifts"—								
Average frozen weight	33·0 lb.		32·7 lb.		31·0 lb.		30·0 lb.	
Total value of lamb—Schedule 1.	**17s. 1½d.**		**17s. 8d.**		**16s. 4d.**		**16s. 5d.**	

* A progress report of these tests by W. B. Miller M.Agr.Sc., and C. P. Goulding, B.Agr.Sc., then manager of the Rutherglen Experiment Farm, was published in the November, 1936, issue of this Journal.

schedule is close to, and typical of, those ruling for the greater part of the 1937 and 1938 spring lamb export seasons.

The chief difference between the two schedules, apart from the fact that prices are likely to be lower all round in the coming year, is the decreased prices for heavy lamb compared with light lamb. Whereas in 1937 and 1938 moderately heavy first quality lamb brought only one farthing per lb. less than light lamb, it is considered likely that this difference will be increased to almost one penny per lb. in the coming year. The two schedules applied in the interpretation of the results are shown in the table opposite.*

As referred to previously, the above results were obtained under conditions of one lift of the lambs at the end of the season. When it is desired to market the first quality early lambs before they become too heavy, it would probably be necessary to make two or three lifts unless the lambs are very even, which, though desirable, is difficult and unusual in attainment.

Quality (grade.)	Weight Range.	Prices per lb. in pence—Dressed Frozen Weight. Schedule 1.	Schedule 2.
		d.	d.
Down	Heavy (8's)—37–42 lb. ..	4⅞	6
Down	Light (2's)—36 lb. and under	5¾	6¼
First	Very heavy (4's)—43–50 lb.	4⅜	5½
First	Heavy (8's)—37–42 lb. ..	4⅝	5¾
First	Light (2's)—36 lb. and under	5½	6
Second	Heavy (8's)—37–42 lb. ..	4⅜	5½
Second	Light (2's)—29–36 lb. ..	4⅞	5¾
Second	Very light—less than 29 lb.	5½	5¾
Third	Heavy—29 lb. and over ..	4⅜	5½
Third	Light—less than 29 lb. ..	4⅞	5½

NOTE.—Down, first, or second quality lambs weighing from 37 to 42 lb. dressed frozen weight, known in the trade as 8's, were described as heavy lambs in this experiment, while lambs 36 lb. and under were called light, or 2's. Very heavy lambs are those 43 lb. or over, but very few carcasses reached that weight. Carcasses were classified as "Down" lambs only when of first quality. Third quality lambs weighing over 28 lb. are described as heavy.

TABLE II.—RUTHERGLEN EXPERIMENTAL FARM.—RESULTS OF FAT LAMB BREED TRIALS, 1935.

	Border Leicester Ram x Half-bred Ewe.		Southdown Ram x Half-bred Ewe.		Border Leicester Ram x Come-back Ewe.		Southdown Ram x Come-back Ewe.		Dorset Horn Ram x Half-bred Ewe.		Ryeland Ram x Half-bred Ewe.	
Number of lambs slaughtered ..	75		88		36		33		76		61	
Average frozen weight ..	34·8 lb.		31·0 lb.		32·2 lb.		29·2 lb.		32·0 lb.		28·5 lb.	
	No.	Average weight.	No.	Average weight.	No.	Average weight.	No.	Average weight.	No.	Average weight.	No.	Average weight.
Quality and weight: Down Heavy (8's)	..	..	10	(38·8)	..	..	..	..	..	..	..	..
„ Light (2's) ..	..	..	23	(31·9)	..	..	6	(32·8)	..	..	..	..
First Heavy (8's) ..	20	(39·4)	..	..	6	(39·0)	..	..	13	(40·3)	1	(38·0)
„ Light (2's) ..	17	(33·8)	20	(30·8)	5	(34·2)	12	(31·9)	10	(33·8)	13	(31·8)
Second Heavy (8's)	4	(37·3)	1	(41·0)	..	..	..	..	1	(37·0)	..	..
„ Light (2's)	26	(32·7)	25	(29·0)	13	(31·6)	11	(26·2)	33	(31·2)	34	(28·2)
Third Heavy ..	6	(33·5)	..	..	6	(30·2)	..	..	5	(29·2)	1	(28·0)
„ Light ..	2	(24·0)	9	(25·3)	6	(26·8)	4	(24·2)	14	(25·6)	12	(25·0)
Average value of carcass—Schedule 1.	14s. 1½d.		13s. 6½d.		12s. 11½d.		12s. 11d.		13s. 0d.		11s. 11d.	
Average value of carcass—Schedule 2.	16s. 8½d.		15s. 4½d.		15s. 3½d.		14s. 5½d.		15s. 2½d.		13s. 8½d.	
Average skin value (1939) ..	3s. 1d.		2s. 6d.		3s. 2d.		2s. 6d.		2s. 11d.		2s. 6d.	
Average fat value	½d.		½d.		½d.		½d.		½d.		½d.	
Total value of lamb—Schedule 1...	**17s. 3d.**		**16s. 1d.**		**16s. 2d.**		**15s. 5½d.**		**15s. 11½d.**		**14s. 5½d.**	
Total value of lamb—Schedule 2.	**19s. 10d.**		**17s. 11d.**		**18s. 6d.**		**17s. 0d.**		**18s. 2d.**		**16s. 3d.**	
Estimated results had the experiment been conducted in two lifts—												
Average frozen weight ..	33·2 lb.		30·3 lb.		31·2 lb.		29·2 lb.		30·7 lb.		28·4 lb.	
Total value of lamb—Schedule 1.	**17s. 1d.**		**16s. 0d.**		**16s. 1d.**		**15s. 5½d.**		**15s. 8½d.**		**14s. 5½d.**	

*The prices of Schedule 1 were those anticipated prior to the outbreak of war.

With the prices expected this season, i.e., with Schedule 1 operating, it would pay to take out the most forward lambs of good quality when they reach an average weight of approximately 33.5 lb. dressed frozen weight, corresponding to 68 and 71 lb. live paddock weights of Southdown and Border Leicester cross lambs respectively.

From recorded live weights in these experiments, it is possible to calculate what the comparative results between the various crosses would have been had the slaughtering been conducted from two lifts. Such procedure would be more favorable to lambs which usually mature at light weights such as the Southdown cross, and to a lesser extent the Ryeland cross, than to the Dorset Horn and particularly the Border Leicester cross lambs.

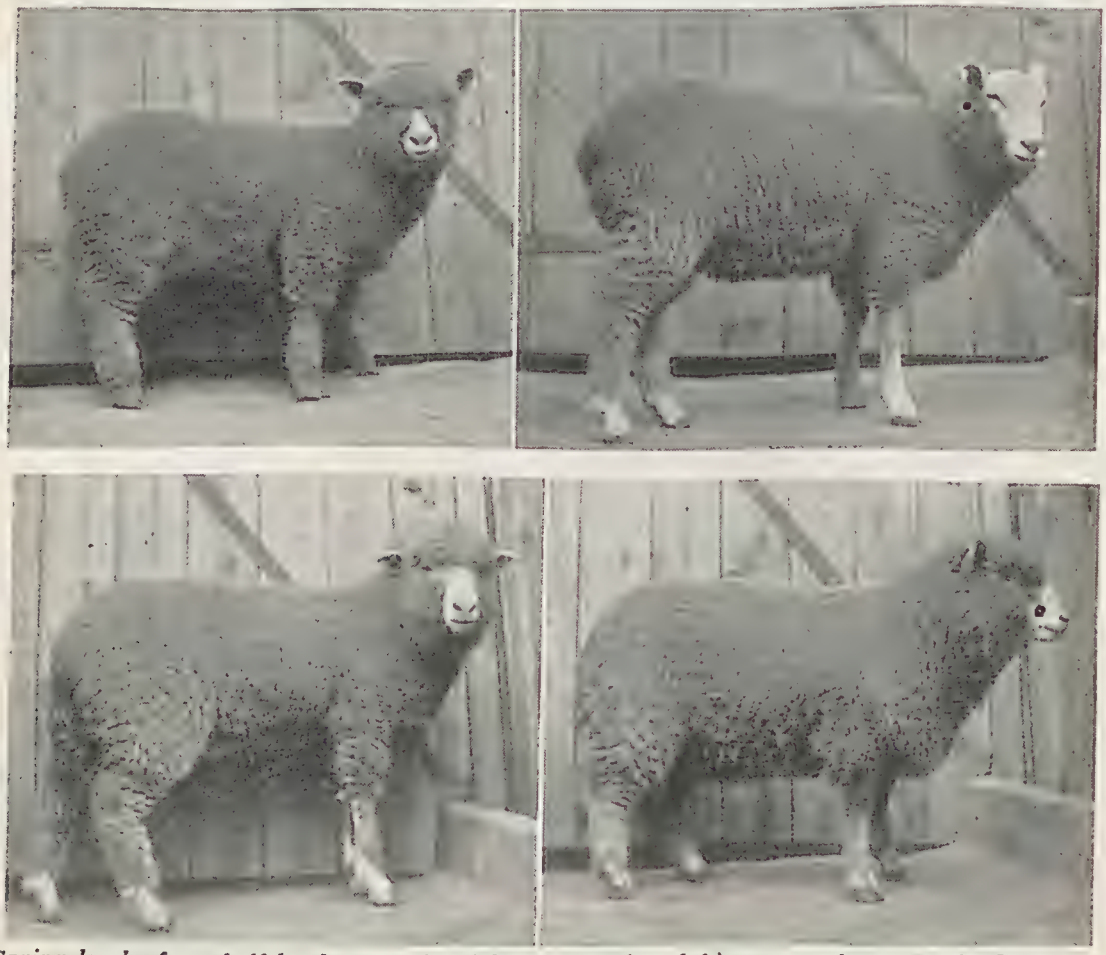
Monetary returns under such conditions, and which are those anticipated for this season, would have been as follows (see also Tables I. and II.):—

—	Return per lamb.	
	1932.	1935.
	s. d.	s. d.
Half-bred ewe x Border Leicester ram	17 1½	17 1
Half-bred ewe x Southdown ram ..	17 8	16 0
Half-bred ewe x Dorset Horn ram ..	..	15 8½
Half-bred ewe x Ryeland ram ..	..	14 5½
Come-back ewe x Border Leicester ram	16 4	16 1
Come-back ewe x Southdown ram ..	16 5	15 5½

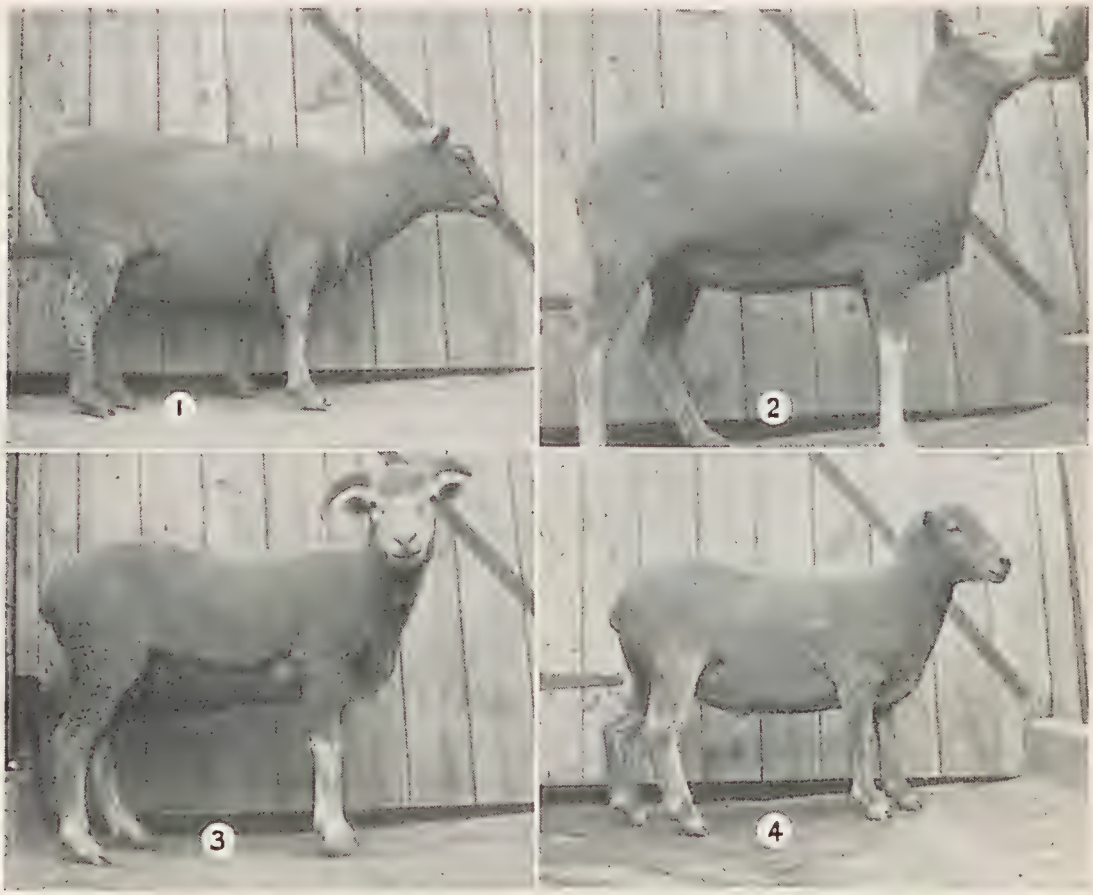
The results of the investigations with spring lambs are discussed at the end of the article.

"CARRY-OVER" LAMBS.

An important consideration of fat-lamb raising in most districts and where pastures are stocked to their average carrying capacity is the problem of the "carry-over" lamb which



Spring lambs from half-bred ewes. Southdown cross (top left) compared with Border Leicester Bottom left: Dorset Horn cross compared with Ryeland cross, (bottom right).



Tegs from half-bred ewes. 1. Southdown cross. 2. Border Leicester. 3. Dorset Horn 4. Ryeland.

is not sufficiently grown or fattened to be saleable for immediate export by the time the pastures dry off. The percentage of lambs marked which come under this category is quite considerable, ranging from 100 per cent. under very adverse conditions to almost nil in a good season. The great majority of the lambs slaughtered for export in Victoria from January to June are "carry-over" lambs fattened after weaning, many on irrigated pastures. Those used for local consumption are also of this type. The total number of such lambs is about three quarters of a million as compared with an export total from Victoria averaging slightly over three million carcasses in the past three years. The Victorian local consumption accounts for approximately one and a half million lambs. "Carry-over" lambs are also held for sale in later years as mutton.

Factors which may combine to cause a departure from the export ideal of fattening all lambs by the early summer in most districts include adverse seasons, late lambings (sometimes due to young ewes), unsuitable ewes, a high percentage of twins in a poor season, and the incidence of disease. If "carry-over" lambs were not produced so regularly, it would be necessary and would pay to retain lambs for local consumption from February to August. The "carry-over" lamb therefore must be considered in any complete discussion of the comparative value of different breeds and crosses, and particularly in relation to marginal districts.

The improved pastures of the Rutherglen and many other districts are regarded as very suitable and safe for fat-lamb production in most seasons and carry up to approximately two ewes per acre in a normal year. Lighter stocking undoubtedly results in less anxiety and higher returns per ewe, especially in an unfavorable year, but, in most seasons, feed

would be so wasted by understocking. It is in the unfavorable season, however, that the light "carry-over" lamb becomes a problem. Many are sold before or after shearing to be fattened in other districts and their value for this purpose varies with their size and condition, but also with their breeding.

Investigations at Rutherglen.

The 1933 season at Rutherglen was unfavorable, and late lambs fared badly. The experimental sheep that year happened to be maiden ewes and the lambing was late, mostly in late June and July. Very few of the lambs were fit for export by November, when the pastures dried off, and it was decided therefore to shear them all (some 320) and to conduct an investigation of the comparative value of each cross as "carry-over" lambs. They did not thrive during the summer and autumn, although more than half of the lambs of some crosses were saleable by May. Those in fair condition and above approximately 25 lb. freezing weight were slaughtered and full records of carcass and skin weights and grades, values, &c., were obtained.

The balance of the lambs were maintained through the winter on sparse pastures and shorn in September, after which they fattened quickly and were slaughtered in November, when some carcasses were graded as "summer" lamb, but most as tegs. The full results of the investigation, expressed in terms of current (August, 1939) meat, skin and wool values based on the recorded information of 1933 and 1934 are set out in the accompanying table.

It is not advisable, nor would it be strictly correct, to assess the total value of each cross on the results of one such experiment at Rutherglen, but certain features are outstanding and generally applicable. The crosses (lots 1 to 6) compared were the Border Leicester and Southdown rams mated with both half-bred (Romney-Merino) and Comeback ewes, and Dorset Horn and Ryeland rams mated with the half-bred ewes only. The management of the experiment was such that

RESULTS OF INVESTIGATIONS OF THE VALUE OF VARIOUS CROSSES AS "CARRY-OVER" LAMBS.
Experiment Farm, Rutherglen, 1933-34.

—	Lot 1. Border Leicester x Half-bred ewe.	Lot 2. Southdown x Half-bred ewe.	Lot 3. Border Leicester x Come-back ewe.	Lot 4. Southdown x Come-back ewe.	Lot 5. Dorset Horn x Half-bred ewe.	Lot 6. Ryeland x Half-bred ewe.
Number of lambs	72	58	21	23	68	67
Average value (1939) lamb's wool shorn December, 1933	1s. 8d.	1s. 3d.	1s. 10d.	1s. 4d.	1s. 6d.	1s. 6d.
Average live weight May, 1934	59.2 lb.	53.9 lb.	52.2 lb.	52.1 lb.	61.2 lb.	54.6 lb.
Percentage lift as summer lambs, May, 1934	51 per cent.	35 per cent.	..	30 per cent.	62 per cent.	36 per cent.
Average weight summer lambs lifted, May, 1934	28.3 lb.	26.9 lb.	..	25.6 lb.	28.8 lb.	26.5 lb.
Average carcass value above summer lambs at— 1st quality 4½d. lb. .. .. 2nd qualtiy 4d. lb. .. .. 3rd quality 4d. lb.	12s. 10d.	12s. 6d.	..	12s. 0d.	12s. 11d.	11s. 11d.
Average skin value summer lambs	2s. 11d.	2s. 4d.	..	2s. 6d.	2s. 10d.	2s. 10d.
Average total value summer lambs lifted	**15s. 9d.**	**14s. 10d.**	..	**14s. 6d.**	**15s. 9d.**	**14s. 9d.**
Wool shorn from remaining lambs (tegs) in October, 1934—						
Average weight	5.4 lb.	4.4 lb.	5.5 lb.	4.6 lb.	4.6 lb.	5.0 lb.
Average 1939 value	3s. 7d.	2s. 7d.	4s. 1d.	3s. 10d.	3s. 1d.	3s. 4d.
Average carcass weight (tegs), November, 1934	36.0 lb.	37.2 lb.	36.6 lb.	34.2 lb.	40.4 lb.	37.7 lb.
Average value teg carcasses based on 1934 grades and weights	14s. 3d.	14s. 8d.	15s. 10d.	12s. 10d.	15s. 6d.	14s. 4d.
Average skin value of tegs	1s. 2d.	1s. 0d.	1s. 3d.	0s. 11d.	1s. 2d.	1s. 0d.
Total value of tegs	**15s. 5d.**	**15s. 8d.**	**15s. 1d.**	**13s. 9d.**	**16s. 8d.**	**15s. 4d.**

NOTE.—Comparative as well as actual wool and skin values per lb. of the different crosses vary considerably with the market demands but length of staple in lambs' and hogget wool is a bigger factor than in ordinary fleece wool.

all ewes and lambs had equivalent (mostly identical) treatment throughout the trial. The mean date of lambing of lots 2, 4, and 5 (i.e., Southdown and Dorset Horn sires) was approximately ten days earlier than in the other crosses (Border Leicester and Ryeland sires).

Summarized Results.

The Dorset Horn and Border Leicester crosses on the half-bred ewe were approximately equal in value as "carry-over" lambs, but definitely superior to the Southdown and Ryeland crosses on the same ewe. This is shown principally by the percentages slaughtered at the end of the autumn at the average weights shown, which were—

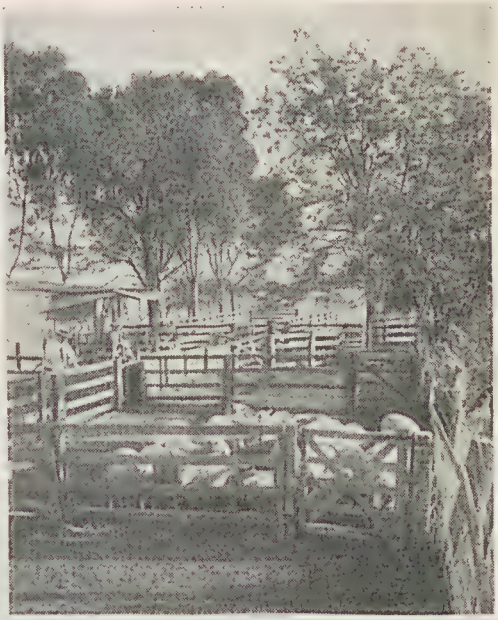
—	Percentage fit for slaughter May.	Average frozen weight of those slaughtered.
	%	lb.
Border Leicester x half-bred ewe	51	28·3
Southdown x half-bred ewe	35	26·9
Dorset Horn x half-bred ewe ..	62	28·8
Ryeland x half-bred ewe	36	26·5
Border Leicester x come-back ewe ..	nil	..
Southdown x come-back ewe	30	25·6

The lambs from the half-bred ewes by Border Leicester and Southdown rams were superior to those from the Comeback ewes.

There was little significant difference between the lambs of the various crosses which were maintained to be shorn and sold as tegs six months later. In this section, the Dorset Horn cross showed slightly to advantage, and the half-bred showed further superiority over the Comeback ewe.

Although the wool and skin values of the Border Leicester, Dorset Horn, and Ryeland crosses were greater than those of the Southdown cross, the differences were relatively small. The influence of the finer and denser wool of the Comeback ewe is evident but does not offset the higher meat-producing potentialities of the half-bred.

The financial returns illustrate the unprofitable consequences of failure to mature lambs before the pasture dries off in the early summer, and the desirability of the sale or transference of such "carry-over" lambs to green pastures or fodder crops in order that they may be fattened as quickly as possible,



Shady sheep yards at Rutherglen.

and before they become tegs. Their retention also may jeopardize the lamb crop of the following year, unless stocking is adjusted.

In other trials at Rutherglen, similar inferences have been drawn in regard to lambs which have been carried over, but it has been quite evident that under reasonably good conditions the Southdown cross matures into first quality lambs with more certainty, earlier and at lower weights than the Border Leicester or Dorset Horn cross. When light-weight lambs are in demand, as at present (August, 1939), or in short seasons, this characteristic is a great advantage.

General Discussion.

As is usual under heavy stocking conditions with variable seasons the lambs did better in some years than others. 1932 was a good year for fat-lamb raising; 1935 was fairly good; but 1933 was most unfavorable. The outstanding results of the trials in 1932 and 1935 are as follows:—

The half-bred ewes crossed with Border Leicester rams produced the lambs of the greatest average frozen weight in both seasons, as shown in the tables.

The half-bred ewes crossed with Southdown rams produced a larger percentage of first quality lambs, including many Down lambs,

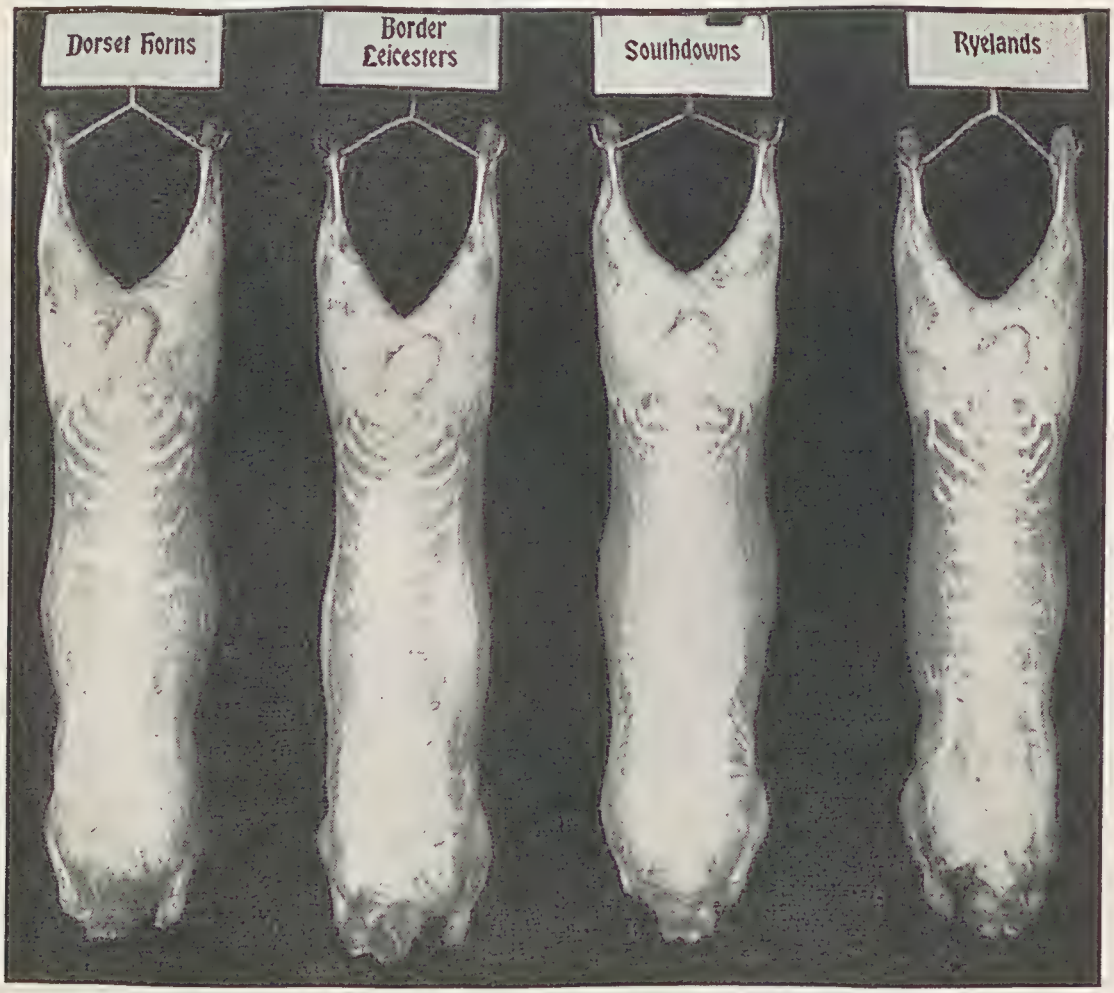
than the other crosses. The percentages of first quality lambs in each cross were as follows:—

	Percentages of First Quality lambs.	
	1932.	1935.
	%	%
Half-bred ewe x Border Leicester ram	71	49
Half-bred ewe x Southdown ram ..	78	60
Half-bred ewe x Dorset Horn ram ..	..	30
Half-bred ewe x Ryeland ram ..	..	23
Come-back ewe x Border Leicester ram	47	30
Come-back ewe x Southdown ram ..	76	55

In 1932, the more favorable season, a greater percentage (70 per cent.) of Southdown cross lambs was graded as "Down" than in 1935 (38 per cent.), illustrating that Southdown cross lambs must be well finished to obtain the maximum premium for the production of this ideal type.

The Southdown cross lambs matured earlier, i.e., reached first quality standard at lower weights than the other crosses. This characteristic is important when early lambs are more valuable than mid-season lambs of equal weight and quality, when light lambs are of considerably greater value per lb. than heavy lambs, and also when, even following a good season, the green pasture goes to seed early.

The average values of the lamb skins at current (August, 1939) values are shown in the tables. Those of the Border Leicester cross were slightly more valuable than the Dorset



Typical first-quality lamb carcasses from the Rutherglen trials. Note the short thick legs and well-covered shoulders and loin of the Southdown lambs as compared with the longer-bodied Border Leicester cross lamb. The Dorset Horn and Ryeland crosses are intermediate in type.

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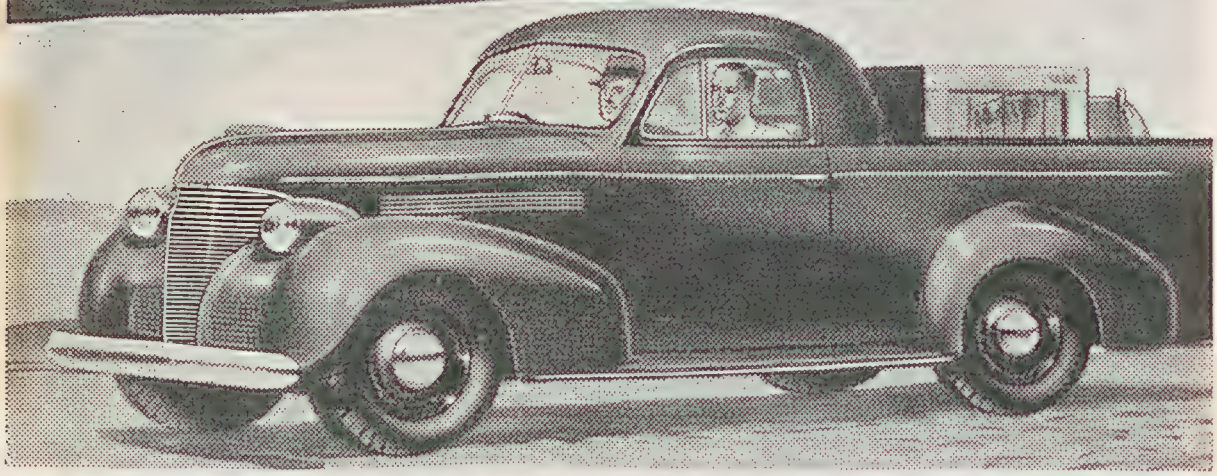

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The comparative monetary returns from each cross vary with the schedule of prices ruling at any particular time. When prices per lb. similar to those anticipated for the current season (Schedule 1) are operative, and in a favorable season with lambs of good quality, the comparative results of the 1932 trials at Rutherglen would be applicable. Under such conditions the Southdown cross lambs from half-bred ewes might be expected to give a greater return (17s. 8d.) than the Border Leicester cross (17s. 1½d.) from the same ewes. It is probable that the Southdown cross would show to greater advantage on Border Leicester–Merino half-bred ewes, which are not so low set and blocky as the Romney Marsh x Merino cross.

Under less favorable seasonal conditions, as occurred in the 1935 trials, the Southdown cross lambs would probably be less profitable than the Border Leicester cross, the returns of that year at Rutherglen being 16s. and 17s. 1d. respectively. Until this year, however, the prices obtainable by selling on the weight and grade basis have approximated more closely to Schedule 2 than Schedule 1, and on such a price basis the Border Leicester cross lambs would have returned a greater profit in both years than those of the Southdown cross.

In 1935 the Dorset Horn cross lambs were less remunerative than the Border Leicester cross on the half-bred ewe. The value of the Dorset Horn ram in a fairly reliable district appears to be principally its ability to mate early in the season, which is not necessarily desirable on improved pastures under present market conditions. It can be particularly useful for mating with fine wool ewes under hot conditions, and where early lambs are required.

The Ryeland breed does not appear to be very suitable for Rutherglen conditions, the Southdown being preferred if the highest quality lambs are desired.

In both years, the lambs from half-bred (Romney Marsh x Merino) ewes gave greater returns than those from the Comeback ewes. The average differences of the two crosses (Border Leicester and Southdown) in the two seasons reviewed was 11d. per lamb on current valuations. This difference is approximately equal to the monetary superiority of the Comeback over the half-bred ewe as far as wool is concerned. It is well known however, although not shown in these experiments, that the half-bred ewe is the more prolific and, as is discussed above, is more likely to mature its lamb in a bad season. There is need, however, for intensive investigations to determine the best and most economic type of breeding ewe for use under various district conditions.

The investigation appears to support the popular belief that the Southdown cross lamb is inferior to crosses with the Border Leicester and the Dorset Horn breeds as a "carry-over" or store lamb, under conditions of dry feed in the summer and early autumn. It does not follow that such would be the case if the lambs were transferred after weaning on to green feed such as irrigated pastures or lucerne, or on to special fodder crops.

It stresses the importance of the provision of sufficiently good conditions to ensure the maturity of the Southdown lambs before they are weaned, and the avoidance of checks to their progress from the time of mating of the ewe mother onwards. The Southdown shows to greatest advantage under favorable conditions, as is evident also in the results of the Rutherglen trials in good and fair seasons.

Summary.

It was impracticable to include in the investigations all breeds and types of rams and ewes, and it should not be inferred that such breeds as the English Leicester, Shropshire, Suffolk, and Corriedale have not special values for specific conditions.

Experimental work with stock presents many difficulties, which factor probably accounts for the lack of factual data on many aspects of the animal industries. The experience gained during the conduct of the fat-lamb experiments at Rutherglen will be availed of in further investigation of breeding, feeding and economic aspects and problems concerned with the production of high-quality lambs.

From the above discussion it will be realized that light-weight quality lambs are comparatively more profitable under the price basis of Schedule 1 than that of Schedule 2. If a higher premium than ¼d. were obtained for "Down" lambs, production of this type would receive more encouragement. If it can be assumed that prices similar to those of Schedule 1 are likely to become permanent, and so make the marketing of light lambs more profitable than heavy lambs, it is likely that there will be some permanent increase in the number of light-weight "Down" type lambs produced in Victoria. It is considered that such a change would be in the general interests of the fat-lamb producers.

State Research Farm

(Continued from page 462.)

TABLE VII.—MANURIAL TESTS ON STUBBLE.

Treatment.	Yield per Acre.			Financial Returns after Deducting Cost of Manure.		
	Wheat, 1933–35.	Oats, 1933–37.	Barley, Malting, 1935–37.	Wheat.	Oats.	Barley.
	bus.	bus.	bus.	£ s. d.	£ s. d.	£ s. d.
No manure	10·9	19·2	19·2	..	..	..
Super., ½ cwt. per acre	11·3	21·0	20·4	—0 1 0	0 1 7	0 1 0
Super., 1 cwt. per acre	11·2	20·1	20·5	—0 3 3	—0 2 2	—0 0 9
Super., ½ cwt. + Am. sulph., ½ cwt.	13·8	26·2	25·1	—0 1 8	0 5 1	0 5 10
Super., 1 cwt. + Am. sulph., 1 cwt.	16·9	30·6	29·4	—0 2 10	0 5 0	0 7 8

A — sign indicates a loss.

The following values were used in compiling this table:—Wheat, 2s. 6d. bush.; oats, 2s.; barley, 2s. 6d.; super., 4s. cwt. super. and ammonia, 8s. 11d. cwt.

Gypsum Trials.—In certain portions of the State gypsum has proved effective in lightening the texture of heavy soils, and following its use the yield of wheat on such soils has been materially increased. This experiment was designed to test the efficacy of similar treatment on the heavy red clay loam soils of the Werribee district. It was begun in 1930 and completed four years later.

Three treatments of gypsum, ½, 1, and 2 tons per acre, were tested against a normal control plot. The plots were grown on two sites on a wheat fallow rotation. There was a material improvement in texture, and this was reflected in the yields of wheat obtained. **As the following figures indicate, an increase of 6 bushels per acre resulted from the use of 2 tons per acre of gypsum.** An examination of the development of the plants showed that this increase was due in the main to the larger number of plants present on the gypsum-treated plots, i.e., a better germination in the lighter-textured soils.

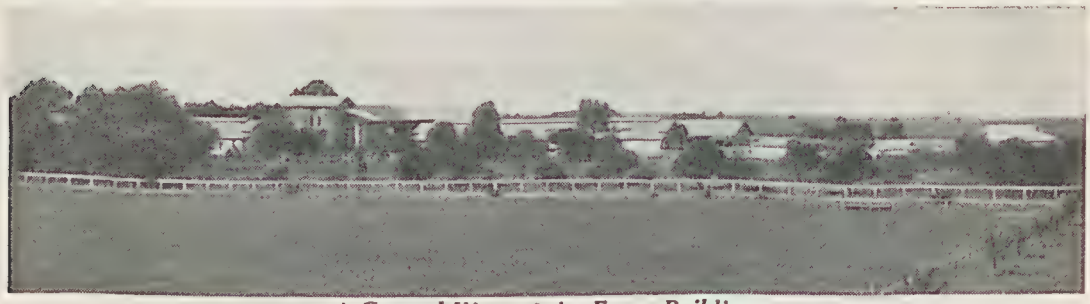
The yields of wheat and the percentage germination of the various plots are shown in the accompanying table.

Gypsum Trials.

Treatments + Super., 1½ cwt. p.a.	Germination Percentage.	Average Yield. 1930–34.
	%	bus. p.a.
Gypsum—		
2 tons per acre ..	62	29·7
1 ton per acre ..	60	28·1
½ ton per acre ..	57	27·3
No gypsum	50	23·6

Seeding Trials (Wheat).

With such a wide range of seeding rates available to the farmer, he naturally seeks some information as to which one is likely to be the most profitable. The time to sow also is of great importance. Sometimes there is no option, the weather or other circumstances being the deciding factor; but, given a choice,



A General View of the Farm Buildings.

and always assuming that the soil is in suitable condition, should the early or late sowing be preferred? Both problems can be conveniently studied together, and this has been done in trials conducted at the farm over a period of sixteen years. The following conclusions have been reached:—

When sown early the amount of seed may vary from 60 to 120 lb. per acre without greatly affecting the yield.

When sown late the best results are obtained from a heavier seeding of approximately 80 lb. per acre.

An average increased yield of 4½ bushels per acre can be expected from early seeding compared with that from late seeding.

The terms early and late, as used here, do not refer to any specific calendar date, but are purely relative. Early sowing, on the average, would take place about the beginning of May, and late sowing about the middle of June.

The tests were conducted in two series, the first for eleven years with 20 lb. as the lowest seeding rate and the second for five years with 45 lb. as the lowest rate.

RATE AND TIME OF SEEDING TESTS.

Average Results with Wheat for Eleven Years (1915-25).

Time of Seeding.	Pounds of Seed per Acre.					
	20	30	45	60	80	120
	bus.	bus.	bus.	bus.	bus.	bus.
Early ..	15·2	17·7	19·3	19·5	21·1	21·4
Late ..	10·8	12·4	14·4	15·9	17·6	17·9

Average Results for Five Years 1926-30.

Time of Seeding.	Pounds of Seed per Acre.					
	45	60	75	90	105	120
	bus.	bus.	bus.	bus.	bus.	bus.
Early ..	18·5	20·1	19·7	19·8	20·0	20·3
Late ..	12·5	14·4	14·5	15·2	15·0	15·4

Diseases of Wheat.

The aggregate toll claimed by plant diseases in Victoria undoubtedly reaches an enormous sum. Furthermore, as some of these diseases are not readily apparent, many farmers no doubt are unaware of the inroads which are being made upon the return from their crops. It is of the greatest importance that the appearance and nature of these diseases should be studied, and due precautions taken to restrict their ravages as much as possible. These objects have received attention on this farm, and some of the work done is described below.

Bunt or Stinking Smut. (Tilletia tritici and T. levis.) *Treatment—Pickle with copper powders, at the rate of 1½ oz. per bushel of seed.*

Bunt was for many years one of the most troublesome and destructive diseases of wheat crops in Victoria, and the best treatment consisted of wet pickling with bluestone or formalin. Due care was not always taken to use these at the proper strength, and as a result injurious effects on germination often occurred.

The tests made here were, in the first place, for the purpose of comparing the respective merits of the wet and dry methods of pickling, and were confined mainly to determining the effect of the pickling on the germination, growth, and subsequent yield of the treated seed.

Counts made upon the field germination of wet and dry pickled seed have shown the dry pickled seed to give regularly a better and more vigorous germination than that of the wet pickled seed. This improved germination and early growth usually are reflected in a small increase in yield, the average results over the six years having been as follow:—

Bluestone, 1¼ per cent.—3 mins.—10.3 bushels per acre.

Formalin, 1–450—3 mins.—10.4 bushels per acre.

Copper carbonate, 2 oz. per bushel—11.3 bushels per acre.

Both the wet and dry treatments give complete and effective control of the disease when applied to ordinary smut-infected seed.

PICKLING TRIALS WITH WHEAT, OATS AND BARLEY (SEED NOT SPECIALLY INFECTED WITH SMUT).

Treatment.	Yields—Average, two years.		
	Wheat.	Oats.	Barley.
	bus. p.a.	bus. p.a.	bus. p.a.
Mercury Compound A ..	20·4	15·5	25·6
Mercury Compound C ..	20·4	16·6	26·2
Copper Carbonate ..	20·0	16·8	25·1
Untreated	..	15·2	25·4

NOTE.—These differences are not significant.

Inheritance of Resistance to Flag Smut in Wheat.
Row 1—Resistant; Rows 2 and 3—Susceptible to disease. The three selections are the progeny of a mating between Nabawa (resistant) and Indian H (susceptible).

Later, trials were conducted to determine the comparative efficacy of the various brands of commercial dry pickling powders and to determine also the value for bunt prevention of other copper compounds not generally used for this purpose.

Trials now in progress are designed to compare the effect on the yields of wheat, oats and barley, of copper carbonate and certain mercury compounds. The results, shown in the accompanying table, indicate that there is no significant difference in yield due to the various powders tested. The seed used in these trials was not specially infected with smut.

Loose Smut.—(Ustilago tritici.) *Treatment—Immersion of seed in hot water and the use of seed from clean crop.*)

Of the three common smuts affecting the wheat plant, loose smut is commonly considered the least injurious. Trustworthy reports, however, indicate that in individual cases losses have occurred to the extent of 25 per cent. of the crop, and it seems likely that this is not an uncommon occurrence in certain localities and in certain seasons. Owing to the fact that the fungus is enclosed within the grain, infection having taken place the previous year at flowering time, it is not reached by ordinary methods of pickling, and some other line of attack becomes necessary.

In 1927, apparatus was installed at Werribee for the purpose of testing the efficiency of a hot water treatment devised by Dr. Tapke in America.

As the accompanying table indicates, immersion for 1 hour 40 minutes in water held at 120 deg. F. has given satisfactory results in controlling the disease. This table gives, in a concise form, the results obtained to date.

As the tests have shown that the treatment of the seed for periods of 1 hour 40 minutes or longer has been effective in controlling the disease, steps are taken every year to treat the more important varieties at various stages as they are grown in the experimental fields.

Treatment.	Total Smutty Heads per 1/20 Acre.			Average
	1927.	1928.	1929.	
Untreated ..	1,603	585	75	754
1 hour, at 120° F. ..	64	155	37	85
1 hour 20 minutes, at 120° F.	27	56	0	27
1 hour 40 minutes, at 120° F.	3	2	1	2

Flag Smut. (Urocystis tritici.) This disease is destructive and widespread. Owing to the fact that the soil becomes infected, it is impossible to control it by pickling the seed.

Measures of control include a good stubble burn, thorough working of the fallow, and a crop rotation which includes oats. The most hopeful and satisfactory means of eradication, however, consists in the use of resistant varieties. Ghurka serves this purpose admirably,

Flag Smut Infection.

Manurial Treatment.	Infection Per cent., 1927.	Infection Per Cent., 1928.	Infection Per Cent., 1929.
Super. 1 cwt.	0·9	3·7	2·1
Farmyard Manure, 10 tons	6·9	17·0	9·7
Farmyard Manure, 10 tons + Lime, 10 cwt. ..	14·7	28·8	18·5
No Manure	1·9	4·4	2·2
Super., ½ cwt.	..	2·2	2·2
Super., 1½ cwt.	..	2·2	1·5
Super., 2 cwt.	..	2·7	1·0
Super., 1 cwt. + Lime, 5 cwt.	7·6	10·9	10·4
Super., 1 cwt. + Lime, 10 cwt.	13·4	14·4	11·9
Super., 1 cwt. + Lime, 20 cwt.	13·2	11·3	10·0
Super., 1 cwt.	3·2	4·0	3·5

being almost immune to the disease, while there are indications that some of the new crossbreds may be even more effective in this respect.

The development of this disease in the Permanent Manurial Field has apparently been favoured by the application of lime and farmyard manure, as indicated in the accompanying table, which shows the counts of infected plants. That superphosphate did not encourage the disease is also shown in this table.

Oat Experiments

The place of the oat crop in Victorian arable farming is second in importance only to that of wheat. The area sown annually to this crop averages over 1,000,000 acres. Its hardy nature is shown by a capacity to thrive under an extreme diversity of conditions and frequently under very rough methods of cultivation. Its grain has peculiarly valuable properties both for milling and feeding purposes, while as a grazing crop it is outstanding, supplying large quantities of nutritious feed, and showing high powers of recovery. It is particularly useful in a rotation, not merely as a change crop, but also for its value in the control of plant disease.

Varieties.

For many years Algerian has been the leading general purpose variety of the State, being productive, hardy and well suited to most districts of Victoria. An earlier oat would, however, be more suited for the drier portions of the State, and much work has been done at the farm in an effort to produce such a variety.

Up to the present three varieties—Palestine, Dawn, and Algeribee, have been evolved. They may be briefly described as follows:—

Palestine.—A very early maturing, drought resisting variety, which is characterized by its short, strong straw. It has given exceptionally

Cutting and stooking a heavy crop of hay.

Harvesting Oats for Silage.

high yields of grain over a wide range of conditions, but is not recommended as a hay variety.

Dawn.—A mid-season strain selected from the variety Sunrise. Somewhat later in maturity than the parent, it is earlier than Algerian. It is definitely stronger in the straw than Sunrise, and gives good yields of hay and grain, particularly in the northern areas of the State. It produces a large bulk of green feed throughout the season and has proved to be very palatable to stock.

Algeribee.—A selection from Algerian which was made available to farmers for the first time this year. The variety bears a general resemblance to the parent, but comes away quicker in the spring. It is slightly taller, producing larger heads and grain, and it matures a few days earlier. Algeribee has demonstrated its superiority to Algerian, in regard to both hay and grain yields on stubble ground, in many different localities.

TABLE I.—YIELD OF OAT VARIETIES FOR VARIOUS PERIODS. ON FALLOW—GRAIN.

Variety.	Average Ten Years.	Average Eight Years.	Average Six Years.
Midseason Varieties.	bus. p.a.	bus. p.a.	bus. p.a.
Richland	42·3	44·3	40·6
Sunrise	39·7	39·3	38·7
Algerian	37·5	39·7	38·9
Dawn	36·4	37·3	36·0
Guyra	..	35·4	35·1
Lachlan	32·9	33·1	32·3
Earlier Varieties.			
Burke	..	..	44·7
Early Kherson	..	..	42·6
Palestine	42·2	42·3	41·0
Mulga	41·8	41·9	40·4
Belar	..	40·6	41·0
Burt's Early	..	..	39·9
Gidgee	..	33·4	38·7

TABLE II.—HAY YIELD OF OAT VARIETIES FOR VARIOUS PERIODS. ON FALLOW—GRAIN + STRAW.

Variety.	Average Ten Years.	Average Eight Years.	Average Six Years.
Midseason Varieties.	cwt. p.a.	cwt. p.a.	cwt. p.a.
Dawn	45·6	44·7	43·5
Algerian	45·4	44·8	42·7
Richland	44·6	44·4	39·6
Guyra	..	42·8	40·3
Sunrise	41·6	39·3	39·1
Lachlan	38·9	37·5	35·4
Earlier Varieties.			
Burke	..	..	42·0
Early Kherson	..	..	42·0
Belar	..	42·3	40·8
Mulga	43·6	41·9	40·0
Gidgee	..	39·8	38·7
Burt's Early	..	..	37·7
Palestine	36·4	35·5	34·1

Variety Trials (Oats on Stubble).

As a considerable area of the oat crop of the State is sown on stubble, certain of the more popular oat varieties have been tested for several years under such conditions at Werribee. In order to make good the deficiency of nitrates which usually occurs in stubble land

TABLE III.—OAT VARIETY TRIALS ON STUBBLE LAND.

Average Yields for Four Years, 1934–37.

Variety.	Yield per Acre.	
	Hay.	Grain.
	cwt.	bushels.
Midseason Group—		
Algeribee	31·8	31·7
Dawn	28·6	26·1
Algerian	27·8	26·7
Guyra	27·0	27·0
Sunrise	25·4	27·8
Early Group—		
Mulga	25·6	29·5
Gidgee	25·2	26·0
Belar	24·9	26·6
Burke	22·8	28·2
Palestine	22·4	24·9

Differences required for significance—Hay 2 cwt., Grain 2 bus.

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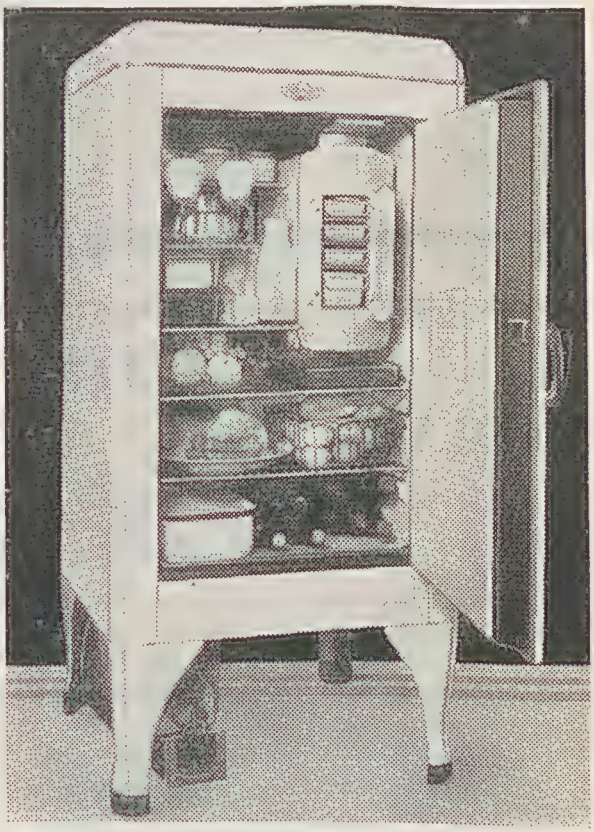

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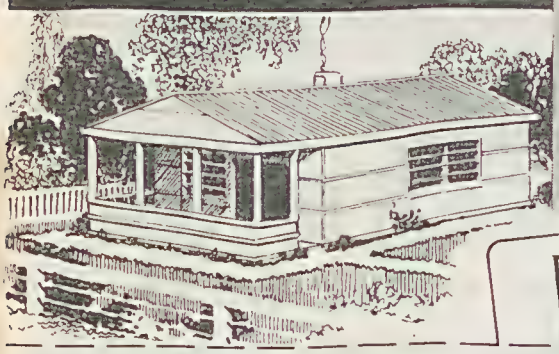

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the plots have received an application of 1 cwt. of sulphate of ammonia in addition to a dressing of 1 cwt. of superphosphate.

The earlier varieties, under Werribee conditions, generally have given better yields of grain but poorer yields of hay than the later types.

Manurial Tests with Oats.

SUMMARY OF RESULTS.

On fallow land superphosphate is normally the only fertilizer required.

The quantity of superphosphate giving the best results is from 1½ to 2 cwt. per acre.

The use of potash, lime and insoluble phosphate cannot be recommended.

On stubble crop the most profitable results are obtained by the use of 1 cwt. of superphosphate with 1 cwt. of sulphate of ammonia.

Permanent Manurial Field (Oats).—A description of the layout of this field is given under the wheat section.

TABLE IV.—EFFECT OF FERTILIZERS ON THE YIELD OF OATS GROWN ON FALLOW.

Average per acre for 13 *years,* 1921-1936 *(immediate effect), and* 4 *years,* 1925, 1926, 1937 *and* 1938 *(residual effect).*

Manurial Treatment.	Immediate Effects.		Residual Effects (Grain).
	Grain.	Grain and Straw.	
	Bus.	Cwt.	Bus.
No manure	17·2	17·7	8·5
Super., ½ cwt.	34·9	32·5	13·6
Super., 1 cwt.	37·1	39·2	19·0
Super., 1½ cwt.	41·7	39·7	22·8
Super., 2 cwt.	43·1	40·7	22·9
Bone fertilizer, 1 cwt.	35·3	33·7	17·4
Thomas' phosphate, 1 cwt. ..	35·7	33·3	14·4
Super., ½ cwt.; Thomas' phosphate, ½ cwt.	36·6	36·1	14·7
Super., 1 cwt.; lime, 5 cwt. ..	38·9	39·0	17·5
Super., 1 cwt.; lime, 10 cwt. ..	38·5	42·6	18·7
Super., 1 cwt.; lime, 20 cwt. ..	36·9	40·8	16·5
Super., 1 cwt.; pot. sulph., ½ cwt.	40·6	38·9	16·5
Super., 1 cwt.; pot. sulph., ½ cwt.; soda nit., ½ cwt.	39·7	38·6	15·8
Super., 1 cwt.; soda nit., ½ cwt. ..	40·6	39·3	16·6
Super., 1 cwt.; soda nit., ½ cwt. (in spring)	40·2	38·9	18·1
Farmy ard manure, 10 tons ..	36·5	39·1	22·9
Farmyard manure 10 tons; lime, 10 cwt.	36·8	40·4	20·4
Super., 1 cwt. (continuously cropped)	18·5	21·5	..
No manure (continuously cropped)	15·6	15·8	..

A comparison of returns from various applications of phosphate on fallow after deducting the cost of the fertilizer is given in Table V. This shows the most profitable application to be from 1½ cwt. to 2 cwt. of superphosphate per acre.

TABLE V.—COMPARISON OF RETURNS FROM VARIOUS APPLICATIONS OF PHOSPHATE WITH OATS ON FALLOW.

Treatment.	Increased Yields over "No Manure".	Profit as Compared with "No Manure".
	bus./ac.	£ s. d.
Super., ½ cwt.	17·7	1 13 5
Super., 1 cwt.	19·9	1 15 10
Super., 1½ cwt. ..	24·5	2 3 0
Super., 2 cwt.	25·9	2 3 10
Bone Fertilizer, 1 cwt. ..	18·1	1 7 8

In this table oats have been valued at 2s. per bushel, super. at 4s. per cwt., and bone fertilizer at 8s. 6d. per cwt.

Residual Effects of Fertilizers.—It is a matter of some interest to ascertain the residual effects of fertilizers on yields and, with this end in view, the usual applications were withheld in four different seasons, viz., 1925, 1926, 1937 and 1938. The means of the resulting yields are given in Table IV., and as with wheat, show—

The residual effects are high.

Farmyard manure and the heavier applications of superphosphate had very definite residual effects.

The above applies in a lesser degree to bone fertilizer and Thomas phosphate.

No residual effects of potassic and nitrogenous fertilizers, after excluding that of the superphosphate used with them, are evident.

Each of the four seasons in which this test was made was exceptionally dry, a fact which may have had some influence on the results.

Threshing oats from the replicated manurial tests.

Manurial Tests on Stubble (Oats).

It has already been mentioned, in the section dealing with wheat, that the manurial requirements of crops grown on fallow may differ essentially from those on stubble. In the latter case there is likely to be a shortage of nitrates, and this must be made up before satisfactory growth can take place. In Table VI. it is shown that greatly increased, as well as more profitable, yields of oats follow an application of sulphate of ammonia in addition to that of superphosphate.

TABLE VI.—MANURIAL TESTS ON STUBBLE LAND WITH OATS.

Average per acre for 5 years, 1933–37.

—	Yields.		Monetary Return after deducting the Cost of Manure.	
	Grain.	Hay.	Grain.	Hay.
	bus.	cwt.	£ s. d.	£ s. d.
No manure ..	19·2	18·3	..	..
Super., ½ cwt. ..	21·0	19·5	1 7	1 7
Super., 1 cwt. ..	20·1	19·2	−2 2	−1 4
Super., ½ cwt. + Am. Sulph., ½ cwt. ..	26·2	24·8	5 1	10 7
Super., 1 cwt. + Am. Sulph., 1 cwt. ..	30·6	29·9	5 0	17 0

In this table the grain has been valued at 2s. per bus., hay at £3 per ton, super. at 4s. per cwt., and sulphate of ammonia at 8s. 11d. per cwt.

Seeding Trials with Oats.

SUMMARY OF RESULTS.

For early sowing use about 70 lb., and for late sowing from 80 to 90 lb. seed.

Whenever possible, sow early.

Rate and time of seeding trials with oats were carried on for some years, but definite conclusions having been reached, they have been discontinued.

On the average, the early crop was sown about the middle of April, and the late about the end of May.

RATE AND TIME OF SEEDING TESTS WITH OATS ON FALLOW.—RESULTS FOR 17 YEARS, 1917–33.

Time of Seeding.	Rate of Seeding in lb.		
	50	70	90
	bus./ac.	bus./ac.	bus./ac.
Early	36·2	39·8	39·3
Late	20·4	22·8	24·3

Diseases of Oats.

The oat crop is not, under Werribee conditions, apparently susceptible to many diseases, but it may be attacked by smuts of several kinds. The most common are covered smut (*Ustilago levis*), and loose smut (*Ustilago avenae*). Covered smut may be kept in check by ordinary pickling methods as used for wheat. The best means of dealing with loose smut is to use seed only from clean crops.

Barley Experiments

Barley is next in importance to oats as a cereal crop in Victorian agriculture. The average annual production exceeds 2,000,000 bushels, of which rather more than 80 per cent. is of the two-rowed or malting type, the remainder being six-rowed or feeding barley. Malting barleys are used for brewing and for the manufacture of foods, while the six-rowed types, apart from a small proportion required for brewing, are used almost exclusively for feeding to stock. In general, the yield per acre of feeding barley is from 10 to 15 per cent. in excess of that of the malting types, but the difference is more than offset by the fact that the malting barleys command a price of at least 25 per cent. more per bushel.

Barley is exceedingly hardy and adaptable, and will yield well under conditions which would be unsuited to wheat or oats. Under good conditions, it produces a large bulk of early green feed, and in this regard is particularly valuable under conditions of irrigation or high rainfall. The bulk of the Victorian crop is grown on stubble land.

During recent years, a considerable amount of investigational work in regard to varieties, manuring, and other problems relating to barley growing has been conducted at the farm.

Varieties.

Malting Types.—The choice of varieties of either malting or feeding barleys is strictly limited by the few suitable ones available. *Of the malting types only two varieties, Pryor and Plumage Archer, are grown to any extent.*

Pryor barley is the standard Australian malting type and has formed the basis of the industry for many years. It is an early maturing variety which yields well, and produces a good quality grain over a wide range of conditions.

Plumage Archer is a comparatively recent introduction from England, and is characterized by the excellent malting quality of its grain. It is, however, rather late in maturity for local conditions, and for this reason is recommended only for the higher rainfall districts and for limited sowings.

Threshing Barley from the variety plots.

During recent years, two new crossbred barleys have been developed at the farm, and are now undergoing final yield trials. Both of these have proved superior to Pryor and Plumage Archer in regard to yielding capacity, and one, Pryor x Plumage Archer, W4463S 1–13, produces a grain of superior malting quality to that of Pryor. This crossbred is of the Plumage Archer type, but definitely earlier in maturity.

TABLE I.—MALTING BARLEY VARIETIES (AVERAGE YIELD).

Variety.	Fallow Land 1932–34.	Stubble Land 1935–37.
	bus./ac.	bus./ac.
Pryor x Plumage Archer, W 4463, S 1–13	..	22·6
Chevalier x Pryor, W 4367, K 3–1	..	21·2
Pryor	42·4	19·9
Plumage Archer	43·5	17·8
Spratt Archer	40·3	16·7
Bushels required for significance	3·0	1·3

Feed Types.—*The most popular six-rowed barley is the variety Cape, which is an early maturing, heavy yielding type, particularly suited to local conditions.* In recent years, a number of promising varieties has been obtained, chiefly from America, and several have been included in yield trials this season. The results from variety trials conducted during the past few years are given in Table II.

TABLE II.—FEED BARLEY VARIETIES. (AVERAGE YIELDS.)

Variety.	Fallow Land. 1933–34.	Stubble Land. 1935–37
	bush. p.ac.	bush. p.ac.
Sea of Azov	56·0	26·1
Sea of Azov x Roseworthy Oregon ..	60·1	24·4
Cape	51·8	24·7
Bushels required for significance ..	3	2

The variety Sea of Azov and the crossbred are of earlier maturity than the standard variety Cape and thus in most seasons are superior to it in yielding capacity.

Manurial Trials (Barley).

The following table gives the results of manurial trials with Pryor barley on fallow land.

MANURIAL TRIALS ON FALLOW LAND—VARIETY, PRYOR.

Treatment.	Average Yield.	
	1932 and 1935.	1933–34–36–37–38.
	bus./ac.	bus./ac.
No manure	30·6	33·6
Super., 1 cwt./ac.	33·7	42·8
Super., 1½ cwt./ac.	33·9	45·0
Super., 2 cwt./ac.	34·8	47·1
Super., 1 cwt. + Am. Sulph., 1 cwt./ac.	43·3	44·2
Difference in bushels required for significance	2·5	2·5

It will be seen that, in the seasons 1932 and 1935, the response to superphosphate was small, while on the other hand, the application of

sulphate of ammonia was responsible for a marked increase in yield. In these years, excessive autumn rainfall was responsible for the washing out of nitrates from the soil, and as a result, fallow sown crops responded profitably to dressings of nitrogenous manures. Seasons of this nature are experienced once in every three or four years at Werribee. In the remaining seasons there was a marked response to superphosphate, but dressings of sulphate of ammonia proved definitely unprofitable. The results in this case are typical of those expected from fallow manurial trials.

The results from a series of manurial trials on stubble land are shown in the next table.

Summary of Results on Stubble Land.

On stubble land the most profitable returns are obtained by the application of a mixture of 1 cwt. superphosphate in addition to 1 cwt. sulphate of ammonia.

The use of the mixed manure has in addition improved milling quality of the grain.

Applications of superphosphate alone are not profitable.

Barley Manurial Trials.—Stubble Land.

Treatment.	Average Yield.	
	Pryor, 1933–37.	Cape, 1935–37.
	bus./ac.	bus./ac.
No manure	19·2	18·3
Super., ½ cwt./ac.	20·4	18·7
Super., 1 cwt./ac.	20·5	18·5
Super., ½ cwt. + Am. Sulph., ½ cwt./ac.	25·1	23·1
Super., 1 cwt. + Am. Sulph., 1 cwt./ac.	29·4	27·4
Difference in bushels required for significance	2·0	2·5

The results are characterized by the lack of response to superphosphate alone, and by the large increases in yield which are obtained from dressings of sulphate of ammonia in combination with superphosphate. The increase in yield with the application of 1 cwt. of superphosphate and 1 cwt. of sulphate of ammonia makes this dressing very profitable, and it is therefore to be recommended for stubble crops under local conditions.

A point which must be considered in all manurial trials with malting barley is the effect exerted by the manure on the malting quality of the grain, as indicated by its nitrogen content; the smaller the amount of nitrogen present, the better will be the grain quality. The results of this investigation are given in the following table.

Grain Nitrogen Content.—Pryor Barley —Stubble Sown.

Treatment.	Nitrogen Content of Grain.				
	1933.	1934.	1935.	1936.	1937.
	%	%	%	%	%
No manure ..	1·27	1·37	1·72	1·28	1·79
Super., ½ cwt./ac.	1·24	1·23	1·66	1·27	1·77
Super., 1 cwt./ac.	1·21	1·31	1·66	1·28	1·78
Super., ½ cwt./ac., Am. Sulph., ½ cwt./ac. ..	1·28	1·19	1·39	1·22	1·60
Super., 1 cwt./ac., Am. Sulph., 1 cwt./ac. ..	1·27	1·15	1·32	1·19	1·52

It will be seen that dressings of sulphate of ammonia have tended to decrease the nitrogen content of the grain and therefore to improve its malting quality.

Rate of Seeding (Barley).

The following table shows the results obtained from tests to determine the effects of various rates of seeding on the yield of barley.

Rate of Seeding Test.—Average Yield, 1932-33 and 1936.—Pryor Barley.

Treatment.	Yield per Acre.
	Bushels.
50 lb./ac.	27·1
75 lb./ac.	27·9
100 lb./ac.	28·3
Difference in bushels required for significance ..	2·2

It will be seen that the optimum amount of seed per acre ranges from 75 to 100 lb.

Diseases of Barley.

Barley is subject to attack by two common smuts. One of these is covered smut (*Ustilago hordei*) and the other loose smut (*Ustilago nuda*). Covered smut is treated by sprinkling a heap of barley, with a solution of formalin; after covering to prevent the escape of gas it should be left for several hours.

The loose smut is best handled by using seed from clean crops only although the hot water treatment as used for wheat, slightly modified, is effective.

Crop Rotation Tests

The early discovery that rotation of crops was essential to good farming has led to the development of different systems suited to the conditions of the area in which they were developed. The Permanent Rotation Field was designed to determine the rotation best suited to the conditions at Werribee.

The outstanding lesson has been that under local conditions a fallow is necessary every second or third year, and that a pea-crop is not a satisfactory substitute for a bare fallow.

The most successful rotations up to the present have been—fallow, hay; fallow, hay, barley; fallow, wheat, pasture; fallow, wheat, oats, pasture.

Permanent Rotation Field.

In this field there is a series of thirteen different rotations. In four of them the principal crop is oaten hay, while in the remaining nine it is wheat. The treatment given each crop is, as far as possible, that of normal, good, local farming practice. Grazing results are obtained by the use of sheep, which are enclosed by temporary fences erected around the required plots.

The various rotation systems undergoing trial, together with the average yields obtained, are shown in the table.

One outstanding result has been the marked increase in yield when either wheat or oaten hay has been preceded by a fallow. In the case of wheat the average increase was 200 per cent., and with oaten hay 83 per cent., over the stubble-grown crop. To a large extent, the reason for "wheat continuously" failing so badly is that such a system is favourable to the growth of wild oats, which crowds out the wheat.

TABLE SHOWING THE VARIOUS ROTATIONS WITH YIELDS AND GRAZING RESULTS.

Average Results.—Sections 1–10, 25 *years*; *Sections* 11–13, 23 *years.*

Section No.	Rotation.	Crop.	Average Yield Grain.	Average Yield Hay.	Sheep Days.	Live Weight Increase.
			Bus./ac.	Cwt./ac.	No./ac.	Lb. per ac.
1	Hay continuously ..	Hay	..	24·1	..	..
2	Fallow, Hay	Hay	..	44·2	..	..
3	Fallow, Hay, Barley ..	Hay	..	45·5	..	..
		Barley	21·3	..	..	..
4	Peas, Hay, Barley ..	Peas	9·9	..	..	..
		Hay	..	27·8	..	..
		Barley	20·4	..	..	..
5	Peas, Wheat, Rape, Barley	Peas	10·5	..	..	..
		Wheat	11·6	..	..	..
		Rape	..	..	158	65
		Barley	29·6	..	..	..
6	Fallow, Wheat, Oats, Pasture	Wheat	19·8	..	..	..
		Oats	19·8	..	..	..
		Pasture	..	..	282	124
7	Fallow, Wheat, Pasture ..	Wheat	18·9	..	..	..
		Pasture	..	..	316	156
8	Peas, Wheat, Rape ..	Peas	8·7	..	..	..
		Wheat	14·5	..	..	..
		Rape	..	..	176	87
9	Fallow, Wheat ..	Wheat	18·3	..	..	..
10	Wheat continuously ..	Wheat	6·1	..	..	..
11	Peas, Wheat, Barley ..	Peas	6·6	..	..	..
		Wheat	10·5	..	..	..
		Barley	17·2	..	..	..
12	Peas, Wheat, Hay ..	Peas	8·2	..	..	..
		Wheat	11·5	..	..	..
		Hay	..	21·5	..	..
13	Rape, Wheat, Hay ..	Rape	..	..	122	58
		Wheat	13·9	..	..	..
		Hay	..	19·4	..	..

Another interesting feature is that the yield of hay in the "fallow—hay—barley" rotation is practically identical with that in the "fallow—hay" rotation. When grown in a three-course rotation with peas and barley, however, the average yield of hay was but little more than when hay was grown continuously. This suggests that the advantages secured by fallowing are of more importance to the hay crop than the nitrogen gathered by the peas.

None of the rotations in which a crop is grown every year has been successful; indeed, the results generally indicate that fallowing cannot be dispensed with, but that a fallow must be included at least once in every three years.

Green Manurial Tests.

It is of the utmost importance to the farmer that his land should have an adequate supply of organic matter or "humus". Without it, the land is hard, cloddy, and difficult to work, and its moisture-holding capacity very poor. The common practice of alternating crop and fallow over an indefinite period is very wasteful of humus, and, if continued long enough,undoubtedly must seriously prejudice the fertility of the land.

The problem then is to find a system of cropping which will be economically sound, and, at the same time, will maintain and, if possible, increase the store of organic matter in the soil. Apart from the application of farmyard manure (see Manurial Trials) other possible solutions are the ploughing-in of a green crop, or the feeding-off of a forage crop and the ploughing-in of the residues.

The last two alternatives are being investigated in the tests in the Green Manurial Field, where they are being compared with the orthodox fallow.

Summary of Results.

1. The yields, when fallow is replaced by greenstuff, show in general a slight reduction.

2. This reduction is more than counterbalanced by the grazing returns from oats, barley, when following oats, and rape, when following wheat.

3. The ploughing-in of green crops, under Werribee conditions, is economically unsound.

4. The returns from the forage crops have been reduced by the following causes respectively, viz., rape, general unsuitability to local conditions and attacks by pea-mites; peas, expense of seed; barley (in rotation with wheat), the presence of "take-all" in the crops.

5. It is essential that the fed-off plots be ploughed immediately grazing is completed in September, in order to secure the longest possible period in fallow.

Green Manurial Tests—Wheat Yields.
Average Results—21 years.

Rotation.	Average Yield per Acre.
	bushels.
Wheat after Fallow	20·7
Wheat after Rape fed off	18·8
Wheat after Barley fed off	11·7
Wheat after Peas fed off	19·8
Wheat after Oats fed off	17·5
Wheat after Rape ploughed in ..	19·7
Wheat after Barley ploughed in ..	11·8
Wheat after Peas ploughed in ..	21·5
Wheat after Oats ploughed in ..	17·5

Green Manurial Tests—Oat Yields.
Average Results—14 years.

Rotation.	Grain Average Yield per Acre.	Grain and Straw Combined.
	bushels.	cwt.
Oats after Fallow	41·9	48·7
Oats after Rape fed off ..	36·6	44·8
Oats after Barley fed off ..	40·4	44·6
Oats after Peas fed off ..	36·2	47·6
Oats after Oats fed off ..	38·7	42·2
Oats after Rape ploughed in ..	37·0	45·9
Oats after Barley ploughed in ..	39·2	42·4
Oats after Peas ploughed in ..	39·9	48·6
Oats after Oats ploughed in ..	36·8	38·7

It will be noted that barley makes a much better showing when grown in rotation with oats than with wheat. The grazing results in each case are not greatly dissimilar; the difference is to be found rather in the grain crops, as a reference to the grain tables will show. The cause of the relatively low yields in the wheat rotation is that barley, acting as a host plant to "Take-all" (*Ophiobolus graminis*) carries the disease over to the succeeding wheat crop with the result that this crop usually is badly infested with it. There is, however, some evidence that the incidence of the disease has been much lighter during the past two or three years than it had been previously.

Rape has not been a satisfactory crop at Werribee. Even under conditions which appear favorable, it does not thrive, and in addition, is very susceptible to injury by pea-mites, which frequently attack it in large numbers.

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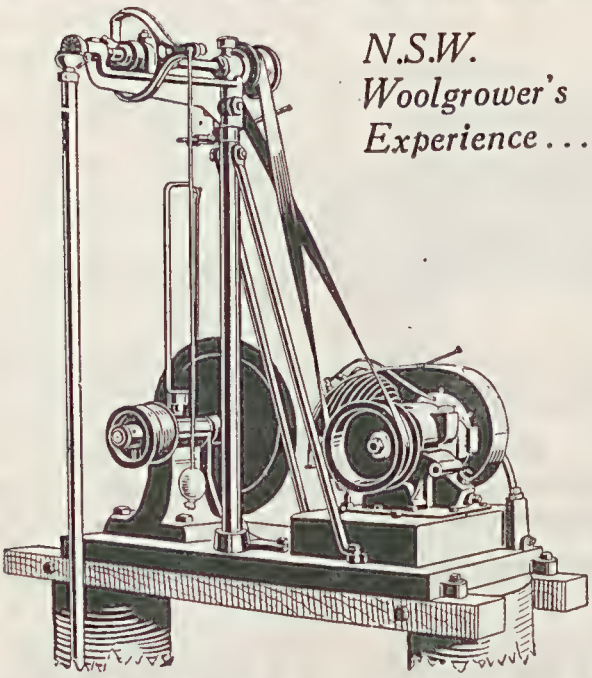

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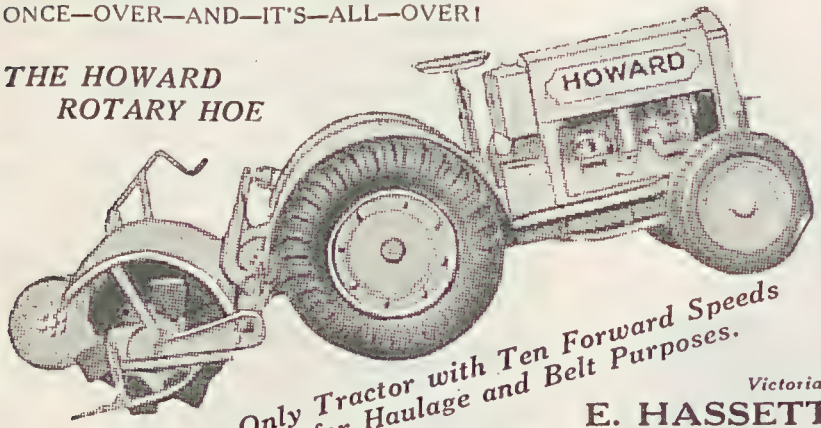

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It may be pointed out that rotations such as those under consideration provide an opportunity for placing the land under a fairly long period in fallow prior to the sowing of the grain crop. If the ground is ploughed immediately feeding-off is completed, this period may easily extend to six or seven months, and there is little doubt that this fallow contributes very substantially to whatever success attends the method.

In the following tables, comparisons are made between the financial returns from the fallowing and the green-cropping systems. The cost, over a two years' period, of producing a green crop followed by a grain crop is naturally greater than that of a fallow and grain crop, since two ploughings and two lots of seed and manure are required instead of one. When estimating the respective values of the two systems, this additional cost must be deducted from the gross returns of the green crop method to give a common basis of comparison. This gives the "net returns" as shown in the tables.

TABLE SHOWING NET RETURNS FROM VARIOUS WHEAT ROTATIONS AFTER PROVIDING FOR THE EXTRA COST OF GREEN MANURING.

Rotation.	Net Returns per Acre.			Difference in Returns when Fallow Replaced by Greenstuff.			
	£	s.	d.	£	s.	d.	
Wheat after Fallow ..	2	11	9	..			
Wheat after Oats, fed off ..	4	9	1	1	17	4	increase
Wheat after Rape, fed off ..	3	5	0	0	13	3	,,
Wheat after Barley, fed off	3	8	0	0	16	3	,,
Wheat after Peas, fed off ..	2	11	1	0	0	8	,,
Wheat after Oats, ploughed in	1	0	0	1	11	9	decrease
Wheat after Rape, ploughed in	1	6	3	1	5	6	,,
Wheat after Barley, ploughed in	0	7	5	2	4	4	,,
Wheat after Peas, ploughed in	0	15	8	1	16	1	,,

NOTE.—In calculating this table, wheat has been valued at 2s. 6d. per bushel, the increase in the live weight of the sheep used at 3d. per lb., and an allowance has been made for wool on the basis of 7s. 8d. per year, i.e., ¼d. per day.

TABLE SHOWING NET RETURNS FROM VARIOUS OAT ROTATIONS AFTER PROVIDING FOR THE EXTRA COST OF GREEN MANURING.

Rotation.	Net Returns per Acre.			Difference in Returns when Fallow Replaced by Greenstuff.			
	£	s.	d.	£	s.	d.	
Oats after Fallow ..	4	3	10	..			
Oats after Oats, fed off ..	6	2	9	1	18	11	increase
Oats after Barley, fed off	5	7	9	1	3	11	,,
Oats after Rape, fed off ..	4	8	2	0	4	4	,,
Oats after Peas, fed off ..	4	1	2	0	2	8	decrease
Oats after Oats, ploughed in	2	10	9	1	13	3	,,
Oats after Barley, ploughed in	2	15	2	1	8	8	,,
Oats after Rape, ploughed in	2	13	5	1	10	5	,,
Oats after Peas, ploughed in	2	1	7	2	2	3	,,

NOTE.—In calculating this table, oats has been valued at 2s. per bushel, the increase in the live weight of the sheep used at 3d. per lb., and an allowance has been made for wool on the basis of 7s. 8d. per year, i.e., ¼d. per day.

RESIDUAL EFFECTS OF GREEN MANURING.

If the organic matter which is being added to the soil by the turning-in of these green crops actually does enrich the soil, this effect should be reflected in increased yields of grain, unless, of course, other factors have been introduced; for instance, the green crops might deplete the soil of moisture, or, as was seen in the case of barley, diseases might be encouraged. An attempt was made in 1925 and 1926, and again in 1937 and 1938, to inquire into this aspect of the question. In the season preceding each of these four years, the green crops were not sown, the whole of the land being laid down to fallow; the succeeding grain crops were thus all sown under similar conditions. The results are given in the accompanying table.

COMPARISON BETWEEN PLOTS NORMALLY GREEN MANURED, BUT FALLOWED ON THIS OCCASION WITH PLOTS NORMALLY FALLOWED. SEASONS 1925, 1926, 1937 and 1938.

Grain Crop.	Green Crop or Fallow.	How Green Crop Utilized.	Yield.	Mean Yields.
			bus. p.a.	bus. p.a.
Wheat	Fallow ..	..	21·2	21·2
	Rape ..	Fed off ..	20·8	
	Barley ..	.. ..	20·5	22·0
	Peas ..	.. ..	22·4	
	Oats ..	.. ..	24·2	
	Rape ..	Ploughed in	18·6	
	Barley ..	.. ..	17·2	20·2
	Peas ..	.. ..	21·1	
	Oats ..	.. ..	23·9	
Oats ..	Fallow ..	.. ..	35·3	35·3
	Rape ..	Fed off ..	34·1	
	Barley ..	.. ..	37·9	33·5
	Peas ..	.. ..	32·0	
	Oats ..	.. ..	30·1	
	Rape ..	Ploughed in	31·7	
	Barley ..	.. ..	37·8	35·1
	Peas ..	.. ..	34·3	
	Oats ..	.. ..	36·6	

A comparison of the mean yields, as shown in the table, does not suggest that any improvement has been effected in the cropping capacity

of the soil as a whole. The best results have been obtained with wheat after oats fed off, where there is a mean increase over the fallow of 3 bushels; this was made up in the four seasons of the following differences, all in favour of the green-manured plots, viz., 1.0, 3.8, 1.8, 5.2 bushels per acre. These increases may be considered significant, and taken in conjunction with the other results in this field, further demonstrate the great value of oats for grazing purposes, when grown in rotation with wheat.

Cereal Breeding

The production of new superior varieties of wheat, oats, and barley by hybridization and selection, is one of the most important and extensive aspects of the research work being conducted at the farm.

A large collection of material, numbering several hundred distinct varieties of wheat, oats and barley, has been built up by co-operation and exchange with Agricultural Departments and Experiment Stations in all States of the Commonwealth, and in numerous overseas countries. Collections of varieties have been obtained from England, France, Denmark, Russia, Algeria, Czechoslovakia, Mesopotamia, India, Japan, China, Canada, United States of America, Mexico, Argentine, Chile, Peru, and New Zealand.

Each variety is grown and studied under local conditions, and those exhibiting desirable characteristics such as earliness of maturity, quality of the grain, resistance to disease, &c., are retained as potential parent forms. Particular attention has been paid to wheats which have been evolved in countries subject to arid conditions and a considerable amount of success has been attained with these, several of the most extensively grown varieties in the State having been produced by the inclusion of Indian wheats in the crossing programme.

Each year a large number of matings of desirable parents is made and the progeny of these are grown and studied in nursery rows in the Stud Cereal Plots.

These rows are culled drastically, and only those hybrids which are fixed in type and exhibit desirable characteristics are retained. These are then grown in field plots, where they are subjected to accurate tests to determine their yielding capacity and general suitability for commercial use. The best of them are then tested at the various departmental plots throughout the wheat belt.

Intensive Breeding by Electric Light.

Recent developments in the breeding work at the farm have made it possible to produce two and sometimes three generations of plants each season. This speeding up of growth is applied only to crossbred material, and is responsible for the saving of two years in the time required for the production of new crossbreds. In order to achieve this a special bird-proof cage, equipped with electric light, has been constructed, in which the extra generations are grown during the summer and autumn months. The first generation is raised between early December and the end of January under natural daylight conditions. By supplementing the normal daylight with electric light a second generation may be grown between the end of January and mid June. The third generation can then be grown under field conditions during the period June to December.

The Departmental Cerealist, Mr. G. S. Gordon, crossing two varieties of wheat.

The work of cereal breeding has many aspects which may be briefly summarized as follows:—

(*a*) Wheat: Breeding for yielding capacity, resistance to disease, milling, and baking quality.

(*b*) Oats: Breeding for yielding capacity, resistance to disease, milling quality.

(*c*) Barley: Breeding for yielding capacity, resistance to disease, malting quality.

(*a*) *Wheat.*

(I.) *Breeding for Yield.*

The breeding of new varieties involves a programme of crossing of suitable parent types, in order to combine their desirable characters in the progeny. This necessitates a knowledge, not only of yield and the factors which go to make up yield, but also of such accessory characters as drought and disease resistance, strength of straw, and ability to hold grain.

A study of the factors which make up yielding ability has formed an important part of the activities of the farm.

Typical heads of Ghurka.

The yield of any crop is controlled in the first instance by two factors, (1) number of ears, and (2) average weight of ear. Analysing these factors still further, we find that "yield" may be expressed as the product of four main factors:—

Yield (Y) = No. of ears (No. of plants (*p*) × No. of ears/plant (*e*)) × Av. Wt. per ear (No. of grains/ear (*n*) × Av. Wt. per grain (*g*))

If accurate information of this character can be obtained varieties then may be classified into groups exhibiting desirable characters of, say, large number of heads, or weighty grain, &c., and thus a guide is given in the breeding and selecting of new wheats.

A study of all the plants in any crop becomes an impossible task when many experiments are to be studied, so that some system of examining certain small portions scattered over the whole area is essential.

A system of sampling has been developed in which crops are examined at three stages of their growth—at germination, at stooling, and at harvest—and accurate counts made of the factors affecting plant development.

Average Figures at Werribee for the "Yield Factors."

—	Rajah.	Ranee.	Free Gallipoli.	Federation.
(*p*) Plants/foot ..	9·25	8·83	8·11	7·02
(*e*) Ears/plant ..	1·30	1·60	1·36	1·44
(*n*) Grains/ear ..	20·0	14·8	17·2	17·3
(*g*) Weight/1,000 grains	33·6	35·8	37·3	30·2
(Y) Yield (bus./ac.) ..	22·2	22·4	20·2	16·0

The figures for the number of ears per plant show that Ranee matures a large number of ears per plant, which however tend to be small in size when compared with the large head of Rajah. An outstanding feature is the large grain of Free Gallipoli when compared with Federation. The final "yield" figures show the material increase of all three new types, Rajah, Ranee, and Free Gallipoli, over the standard Federation, achieved in each case by a superiority in a different "yield" factor.

A study of the relation of the number of stools produced in spring to the number of heads matured at harvest has provided results of interest. Those varieties which can produce from a given quantity of vegetative spring growth the greatest number of ears at harvest should tend to be more economical in

Wheat Breeders at Work.

food and water requirements, and therefore may be more drought resistant than other types. Thus it is possible that the figure of "percentage survival" of ears and stools may be a direct measure of drought resistance. The figures for the above four varieties at Werribee are as follow:—

AVERAGE FIGURES FOR "PERCENTAGE SURVIVAL" AT WERRIBEE OF EARS AND STOOLS.

—	Rajah.	Ranee.	Free Gallipoli.	Federation.
No. stools per plant ..	2·37	2·92	2·89	3·38
No. ears per plant ..	1·30	1·60	1·36	1·44
"Percentage Survival"	55%	55%	47%	43%

It is significant that all the new varieties which have proved themselves superior to Federation in the drier districts of the State show a material increase in this "survival" figure. The "census" analysis of yield has been extended to include many other trials, not only with wheat, but also with barley and oats, and in this manner the interpretation of the action of rates of seeding, manuring, and other allied problems has served a most useful purpose.

(II.) *Breeding for Disease Resistance.*

Special attention is being devoted to the production of prolific varieties which will be resistant to one or more of the various fungus diseases which take their annual toll of the wheat crops. This aspect of the work necessitates the growing and testing of the new crossbreds in a special disease nursery (the quarantine field) where every grain is inoculated with the specific disease prior to sowing. The main aspect of this work is the production of varieties of wheat resistant to flag smut (*Urocystis tritici*). A number of standard varieties are being tested annually to determine their reaction to the disease and in this way resistant forms have been isolated. These are now being used as parents for mating.

Investigations at the farm have indicated that the character for resistance is inherited and further work is in progress to determine the actual mode of inheritance.

The field testing of new crossbreds for flag smut resistance has been transferred to the Mallee Research Station at Walpeup, where it has been found that conditions are more favourable to the development of the disease.

It is worthy of note that several Werribee productions, including Ghurka, exhibit a high degree of resistance to flag smut.

Efforts are also being directed toward the production of varieties resistant to loose smut (*Ustilago tritici*), and, in this regard, the variety Forward, which is resistant to the disease, but which is a poor yielder, has been mated with the more prolific but susceptible local varieties. Attention is also being directed towards the production of varieties which will resist the attacks of stinking smut and of rust.

(III.) *Breeding for Milling and Baking Quality.*

Improvement of the milling and baking qualities of Victorian wheats, by hybridization and selection, provides one of the most important phases of the breeding work. A collection of the highest quality wheats available in the world is being built up, and the more promising of these are being used as parents for mating with the best yielding Australian forms, in an attempt to produce new varieties combining the three desirable characters—quality, flour colour, and prolificacy.

The work involves the conduct of more than 3,000 laboratory tests each year. While undergoing final yield trials prior to naming, all crossbreds are subjected to milling and baking, and other tests of a more accurate nature than those applied in the early stages of breeding.

(*b*) *Oats.*

(I.) *Breeding for Yield.*

In the case of oats the main objective has been the production of prolific, drought-resistant varieties suitable for hay or grain. In addition, attention is being directed to the breeding of varieties suitable for early green feed.

(II.) *Breeding for Disease Resistance.*

Attention is also being devoted to the breeding of varieties of oats which will be resistant to the two diseases—Loose Smut (*Ustilago avenae*) and Covered Smut (*Ustilago levis*). For this purpose resistant varieties have been obtained from America and are being mated with the local high yielding forms. The progeny will be tested for resistance by a method similar to that adopted for testing for flag smut resistance in wheat.

(III.) *Milling Quality.*

In recent years a great deal of attention has been paid to the production of varieties especially suited to the requirements of the milling trade, and all new crossbreds are subjected annually to a close examination to determine their suitability in this respect.

(*c*) *Barley.*

(I.) *Breeding for Yield.*

The breeding programme in regard to barley embraces the improvement of both malting (two-rowed) and feed (six-rowed) types. During the past few years more than 150 new varieties of barley have been imported from many countries.

Crossbred Wheats under test in "Long Rows."

One object of these importations is to secure early maturing forms, which may be used as parents with the local varieties for the breeding of superior new varieties suited to the Victorian environment. Earliness of maturity is regarded as essential under Victorian conditions, in order to enable the plant to escape the hot northerly winds, which result in decreased yields and inferior grain samples.

In addition attention is being directed towards the production of smooth-awned barleys, with the object of eliminating the objectionable, rough, barbed beard so characteristic of the common varieties. In all some 900 new crossbreds are undergoing trial in the Stud Cereal Plots.

(II.) *Breeding for Disease Resistance.*

Varieties which are resistant to the common smuts of barley—Covered Smut (*Ustilago hordei*) and Loose Smut (*Ustilago nuda*) have recently been obtained from Europe and are now being used as parents for mating with local varieties.

(III.) *Breeding for Malting Quality.*

Particular attention has been paid to the production of new varieties combining earliness of maturity, yielding capacity, and superior inherent malting quality. Barleys obtained from England and Czecho-Slovakia have proved to be superior in regard to inherent malting quality and some of these have been mated with local varieties, and with certain early maturing Indian forms. From the progeny of these matings, numbering some hundreds of thousands of plants, three or four hundred distinct lines have been isolated and are at present undergoing trial in the Stud Cereal Plots. Several of the more promising of these crossbreds are undergoing final yield tests in the Replicated Barley Plots.

Types of Plots Employed.

(1) *Stud Plots.*—The stud plots consist of 5,900 rows, each from 5 to 20 yards in length. These form the nursery for new crossbreds and selected plants. Single plant testing is the basis of the work, and, to make this practicable, seeding is done by hand, the seeds being dropped singly several inches apart. Crossbreds remain in these plots until at least the fourth generation.

(2) *Long Rows.*—There are 1,144 long rows, each 5 chains in length. In these are sown the most promising types from the stud plots. The rows are sown singly, about 3 feet apart, with an ordinary seed drill, the spacing being obtained by closing the necessary number of grain runs. The yields of grain are measured and recorded from this stage onward.

(3) *Selection Plots.*—The selection plots represent the next step in production. The plots sown are each 5 chains in length, and from 3 to 4 feet in width.

(4) *Variety Plots.*—These being about ¼ acre in area are grown under conditions which, for the first time in the process of testing, approximate those of ordinary field crops.

(5) *Replicated Yield Trials.*—All varieties are subjected to two stages of accurate yield tests. As soon as possible after promotion from the stud plots they are grown in the "junior tests," in which the yields of duplicate small plots of each variety are compared with the standard variety. The best of these are then promoted to the "senior yield trial" where they are sown in quadruplicate plots of one-fortieth of an acre in area; they must prove themselves over at least three or four years in these trials before they can be distributed to farmers.

(6) *Seed Plots.*—The 49 seed plots average about one acre in area and are used solely for the purpose of seed multiplication. Only those standard and crossbred varieties which have shown superior yielding capacity are admitted to these plots. Before sowing, the seed is subjected to the Tapke hot-water treatment for the prevention of loose smut, and then, before harvesting, the crop is carefully examined and all foreign varieties removed. The seed from these plots is used to sow the bulk areas from which is produced the grain distributed to farmers.

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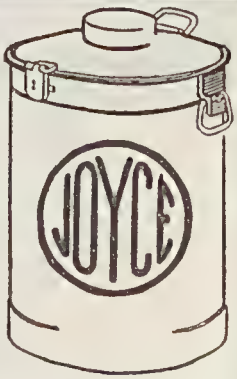

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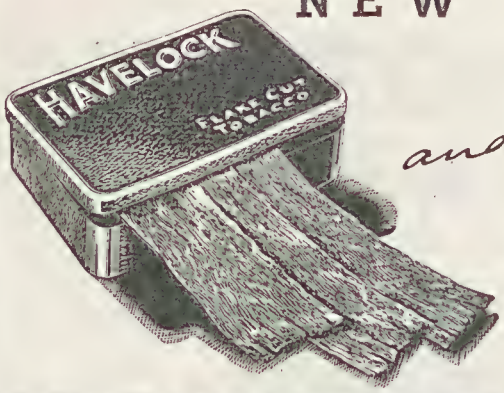

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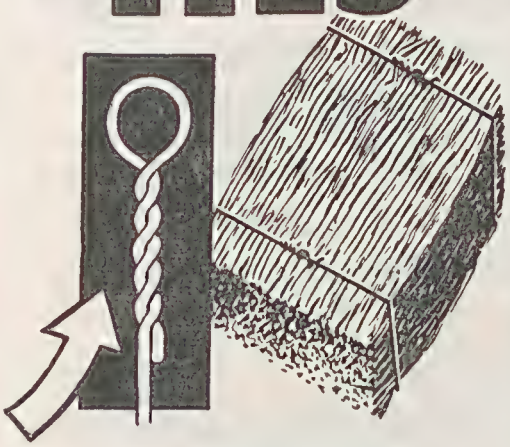

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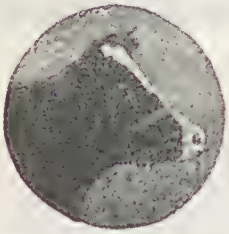

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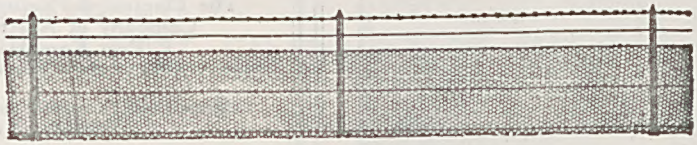

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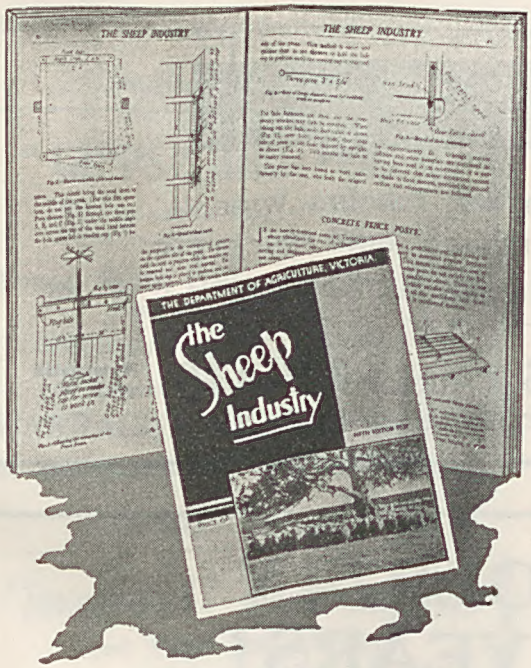

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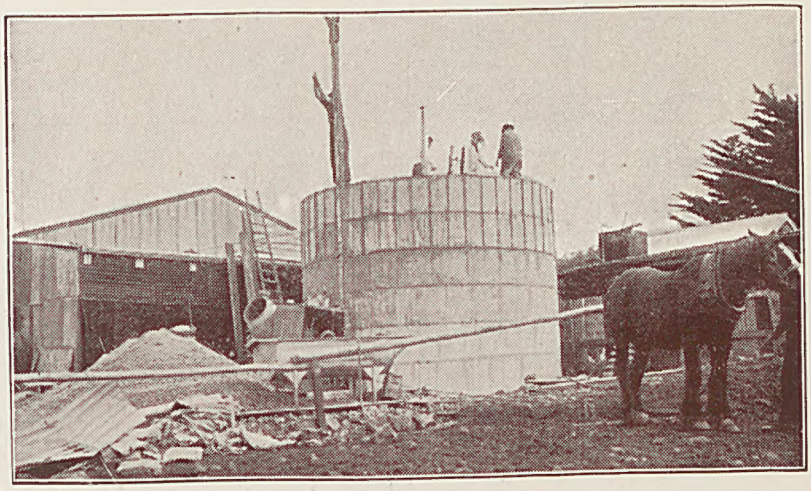

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